

SCIENCE

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FRIDAY, JANUARY 5, 1900.

EDWARD ORTON, EDUCATOR.*

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

I RESPOND this afternoon to a summons difficult to obey but impossible to deny. I am reluctant to undertake what could be done so much better by others, but it is impossible for me to decline to join in doing honor to the memory of one whom I so much loved and admired, however feeble and inadequate my words may be.

My association with Dr. Orton extended through a period of nearly thirty years. Beginning as a casual acquaintance, such as is common among men engaged in the same occupation, it rapidly ripened into a friendship which, happily for me, grew in strength with the years as they passed. My most intimate personal relations with him existed during the earlier years of the Ohio State University, the institution to which he gave so large a share of his life's work, and which to-day makes fitting acknowledgment of the value of that work and of the irreparable loss which it has sustained in his death. Of Dr. Orton as one of the most eminent of geologists of his time, of the splendid example which he set in the performance of the duties of plain citizenship, and of the many other striking characteristics of a career which is rarely paralleled, others will speak, and I will re-

*Read at a Memorial Meeting, Columbus, Ohio, November 26, 1899. A portrait of Orton was published as a frontispiece to the issue of SCIENCE for September 1, 1899.

strict myself, therefore, to remarks upon his earlier work in this university and his influence as an educator rather than as a specialist.

I firmly believe that no one can fully understand and fairly evaluate Dr. Orton's services to the university during the first ten years of its existence who was not himself in some way or other a part of its official organization during those years, and in close touch with methods and motives by which its future career was determined, and I must ask your indulgence in a brief statement of some of the conditions under which the institution came into existence.

The Act of Congress which created this and many other noble institutions of learning, having been passed in the most discouraging and gloomy year of the great Civil War, did not receive immediate consideration and acceptance by many of the States, and in Ohio there was a delay of nearly ten years before those interested saw definite promise of the actual realization of their hopes. In the meantime and during the latter part of this period there was much necessary and useful discussion in regard to the character and scope of the proposed school. Innumerable schemes for utilizing the prospective income were thrust upon the public, and there was much strength in support of a division of the fund among several existing institutions. The first board of trustees courageously resisted all attempts to destroy by disintegration, and it was finally determined that the institution should be located at Columbus and known as the Ohio Agricultural and Mechanical College.

The field of controversy was now greatly narrowed, but was, perhaps, correspondingly more intense. The character of the work of the new school, the scope of its courses and their relation to the requirements of a liberal education were yet to be determined. On the one hand were those

who urged a generous interpretation of the Act of 1862, and who believed that it was primarily intended to furnish the foundation of an institution which might in time become a great university for all of the people; that while, in the provisions of the Act the nation had determined to fortify and invigorate the two great sources of the State's material prosperity, agriculture and manufactures, especial emphasis had also been placed upon the importance of fostering the more purely intellectual or culture components of a well-rounded course of study, for it was specifically directed that these must not be neglected. On the other, was a considerable group of men, equally honest, conscientious and well meaning, who wished to organize a school, intensely practical in tone and atmosphere, in which even science would have found no place except as applied science, and which would have offered little opportunity to those—and, fortunately, they are many—who seek to show their right to labor in the higher regions of more purely intellectual activity. Both sides of this most important controversy were represented by strong men in the first board of trustees, and it is but justice to all to say that the conflict was waged in a manner worthy of the dignity of the occasion and of the great trust for which they had become responsible. I cannot here even refer to the various phases of this discussion or to those who were most active and influential in shaping the organization of the school, nor can I omit saying that to the first president of the board of trustees, Valentine B. Horton, and to Joseph Sullivant, then and long one of the leading citizens of Columbus and of Ohio, the University will ever be indebted for the exercise of a courage, tact and unwearying effort that went far to put the institution in the way of being what it has been, is, and is sure to be in the future. Fortunately, they were supported by many others

of the board, who, in themselves, represented liberal culture, combined with a genuine democracy of feeling and a loyalty to the Commonwealth, compelling the belief that nothing was too good for the children of the people.

The issue was made and met in the appointment of the first faculty of instruction; and in the selection of the first presiding officer fortune was singularly favorable to the new school. A professor in a New England college who has received the highest political honors his State could confer upon him had been invited to become the president of the college, but circumstances arose which made his acceptance impossible. Dr. Orton had been in Ohio only a few years, but he had become widely and well known, not only on account of his accomplishments as a geologist, but as well by his charming personal qualities, and he had been already chosen to fill the chair of geology. To him the trustees now turned, and he reluctantly consented to be the first president of the Ohio Agricultural and Mechanical College. I say reluctantly, for it was well known among his friends and associates that he was loath to assume administrative duties which must necessarily interfere with the continued pursuit of his specialty in which he was already recognized as an authority. Happily for the institution he yielded his personal preferences, and for eight years he was at once president and professor.

Among the several thousand young men who crossed college thresholds in Ohio in the autumn of 1873 seventeen entered the building in which we now are, and enrolled themselves as students, the first of the many thousands who have since followed their example. I cannot describe and few can appreciate the many trials and difficulties of those earlier years. The institution was practically unknown, even among those from whom its patronage was most

likely to come. It stood for a new departure in education which was just entering upon its experimental stage, and with few exceptions it was looked upon with suspicion by other colleges in the State. The members of its first faculty, of whom only four are now living, were mostly young men, full of ambition and enthusiasm for their work and thoroughly in harmony with the spirit of the time, for even then had come the dawn of the marvelous last quarter of the wonderful nineteenth century, a period during which, short as it is, the relation of man to the material universe to which he belongs has undergone a far greater change than in any other period in history. It is often, indeed generally, possible in looking backward upon things accomplished to see many mistakes that might have been avoided and many opportunities not properly utilized. As I review, however, the principal events of Dr. Orton's presidency of this institution I am at a loss to say, even with the better knowledge that accompanies retrospection, how the many emergencies that presented themselves could have been met more wisely. To begin with, his standard of educational work was of the highest type. He fully realized that the success of the institution depended on the establishment and maintenance of a standard of scholarship so high as to compel the respect of the best educational forces not only at home but abroad. Himself a scholar in the broadest, best and most exacting sense, he encouraged faculty and students to seek the best ideals, and no one of them who gave the slightest indication of the possession of the *divine afflatus* in learning ever failed of appreciative recognition from him. He believed that the character of an educational institution should be judged by the quality of its work rather than by the number of students enrolled in the annual catalogue, a principle which everybody admits and nearly every-

body ignores. To stand up for it and do it, especially during the early struggling years of a college, demands a courage that few possess. That Dr. Orton did this, even under the most trying conditions, I set down as, on the whole, the most notable characteristic of his career as president. For I am thoroughly convinced that if he had chosen to do otherwise, if the doors had been opened wide, at both ends of the curriculum, the institution would have long since sunk into a deserved oblivion.

Few college presidents have so continuously received the loyal support and sympathy of their colleagues in the faculty as did Dr. Orton. A college faculty is not likely to shine as an example of meek and amiable submissiveness, and this is particularly true of one composed, as this was, and many are to-day, of specialists. Twenty-five years ago, and earlier, it was usually believed that a college professor might fill any chair that happened to be vacant, and indeed more or less regular interchange of duties was often regarded as highly desirable. The passing of the era is to be attributed in a large measure to the example and influence of institutions of which this is a type. The specialist, however, is tolerably certain to hold that his own particular department is of far greater importance than any other, and he may be relied upon to desire and demand a large share of available resources to aid in its development. Upon the president falls the by no means agreeable task of apportionment and restraint, and this duty was discharged by Dr. Orton with rare discrimination, fairness and tact. No mere administrator, however skilled in that capacity, could have done as well. His scholarship was thorough and yet broad enough to enable him to know what was being well or indifferently done in every department, and is there not a freemasonry among scholars which makes mutual recog-

nition easy even when there is no common language? I am reluctant to refer to my own personal experience on an occasion which is completely filled with one personality; but I can never forget the many instances in which I received from him encouragement in the way of sympathetic acknowledgment and often praise, for work which was doubtless trivial and unimportant, but the recognized success of which served to keep alive the fires of ambition, enthusiasm and interest.

Of Dr. Orton's relations to the students, whose numbers multiplied many times during his presidential period, it is hardly necessary to speak. Too often the president of a college is unfortunate in that he rarely comes in close relations with students except to administer reproof or define restraint. The discipline of this college in its early years was nearly as great a departure from accepted traditions as were its methods of instruction. A large degree of freedom was allowed without the asking, but the line separating liberty from license was sharply defined. It was intended to cultivate a spirit of manly self-reliance together with a full knowledge of the responsibilities of citizenship, and the administration of the few simple regulations was always so just and fair that no ground for complaint could be found. In this as in all his relations with others Dr. Orton believed in the efficacy of reason and in the doctrine that it is generally more important to convince a young man that he has done wrong than to punish him for so doing. He was slow to condemn and reluctant to punish, but I have known few men more inflexible and unflinching when a vital principle was contested. He won the confidence of all with whom he came in contact, and young and old valued his judgment, and advice. As a teacher he was most inspiring. His literary and linguistic powers were unusual, and he easily made any topic attrac-

tive, even to the dull. From hundreds of his pupils comes the testimony that to him they owe the first quickening of their intellectual life, the earliest revelation of their own moral obligations and responsibilities. There can be no higher praise than this.

Complete as was Dr. Orton's success in everything concerning the internal management of the college, his services as its representative in all its relations to the outside world were of far greater importance. The young institution was but coldly received at first, and this was especially true among those who ought to have been its friends. There were numerous harsh and unjust criticisms of its course of study, its faculty, its board of trustees, and it was even attempted by a few men of influence to make it a football of partisan politics, so that its organization might be completely changed with every change in State administration. Against these and many other adverse conditions its board of trustees, president and faculty had to contend. The confidence of the people had to be won and was won, largely by the strenuous but tactful efforts of the president. An eloquent exponent of the progress of scientific thought, in more departments than one, Dr. Orton was everywhere welcome upon the lecture platform. In cities, towns and villages, in grange and farmers' institute, in teachers' convention and literary society, whenever men and women met to foster intellectual growth, he was heard with delight and approbation. His speech was choice, yet simple, clear and dignified, often rising to an eloquence, never of sound or mere words, but of noble thought. Fortunate, indeed, was the new college in having so splendid an exponent, and it is not strange that gradually but surely there came to its support a large and influential constituency from among the best people of the State.

Nor was there any lessening of his influence in its behalf when, after several attempts and against the wishes of the friends of the college, he induced the board of trustees to relieve him of administrative duties and allow him to devote his entire time to his professorship. After that time much of his most important scientific work was done, and as State geologist he became, even more than before, familiar with every nook and corner of the State. His broad democracy of spirit and his generously helpful disposition combined to put him in close touch with the great industrial interests of Ohio, including man as well as matter. He knew the miner as well as the mine, and it would be difficult to measure the value to the university of his almost unique relations with the productive forces of the Commonwealth. The beautiful and noble building which bears his name, and which, from this time on, will stand as a monument to his memory, bears witness, in the very stones of which it is composed, of the readiness with which these forces responded to his touch.

But still more enduring will be the traditions of his life and work in and about this institution, his charming personality, his felicitous speech, his lofty moral and intellectual ideals.

His title to high, perhaps highest, place among the great benefactors of the university, those who by wisdom and tact first made its existence possible and afterward its destruction forever impossible, rests upon a foundation as solid as that of the rocks he so much loved.

"Say not of me that I am dead," were the last words of a great English poet; "Say not of him that he is dead" are our words to-day; speaking for the few who have been privileged to enjoy the most intimate personal friendship, as well as for the many, scattered over this broad land; for all our lives have been better and will be

better because of their having intermingled with his.

THOMAS C. MENDENHALL.

WORCESTER POLYTECHNIC INSTITUTE.

EDWARD ORTON, GEOLOGIST.*

IT was in the autumn of 1869, just thirty years ago, that I first met Dr. Orton. In that year the Second Geological Survey of the State was inaugurated under the directorship of the late Professor Newberry; Governor Hayes named Dr. Orton as one of the two principal assistants for which the law made provision; and it was my own privilege to be accepted, at the same time, as a volunteer aid. In the arrangement of duties Dr. Orton took charge of work in the southwest quarter of the State, and Dr. Newberry gave chief attention to the northeast quarter. Being assigned to Newberry's corps, I had no opportunity to meet Dr. Orton until late in the season, when I had the good fortune to be bidden to attend a conference of the chiefs at Columbus. While on the journey from Cleveland, Newberry prepared me for the meeting by sketching the quality and character of his colleague—a man without guile, direct in his conversation, and absolutely transparent as to motive. The simplicity of manner which would impress me at the start was not of manner merely, but was a fundamental trait coördinate with, and not contradicted by the wisdom which made him a man of affairs. His sensitive conscience making him peculiarly careful to adhere to the facts of observation, he was cautious and conservative in all his geologic work.

Newberry's description naturally made a strong impression, and in the conference that followed it is probable that I gave as much attention to the man as to the subjects of discussion. Certain it is, that the

* Read at a Memorial Meeting, Columbus, Ohio, November 26, 1899.

geologic themes have vanished from my memory, while the picture of the man remains. In later years, as we met from time to time, as I listened to his voice in public address or read the papers that emanated from his pen, I was able to add here and there a detail which Newberry's sketch had failed to delineate, but no line of it was ever erased, and Orton has remained for me one of the safest and most open-minded of investigators and the simplest, kindest, and most lovable of men.

To what extent considerations of historical fitness may have determined the arrangement of to-day's exercises I do not know, but certainly there was peculiar propriety in giving first place to Orton's work as an educator. During the first half of his period of intellectual activity education was the primary theme, and it was only in later years that geology assumed prominence. We are told that his first geologic observation was undertaken with the distinct purpose of increasing his efficiency as a teacher of geology, and in his early acquaintance with rocks and fossils his point of view was educational. Interest in geologic studies for their own sake was a matter of development, and many years elapsed before it assumed control in the determination of his fields of activity. This peculiarity of his introduction to the science in which he finally achieved distinction had much to do with the quality of his scientific work and scientific writings.

It determined, in the first place, that he should not specialize at the beginning of his career. In geology, as in medicine, there are general practitioners, broadly versed in the principles and particulars of the science, who are prepared to undertake and conduct investigations of great variety; and there are specialists, each devoted to some minor branch of the general subject, in which he works intensely and exhaustively. The specialist, restricting his attention thus to

a narrow field, is almost necessarily a somewhat narrow man, and while his concentration of effort may lead to important results altogether unattainable by the general student, he is subject to great danger from lack of balance. The teacher of geology is compelled by his vocation to acquaint himself with all branches of the science, so that his view is necessarily broad, and if he is also an investigator in a special field he is comparatively exempt from the recognized dangers of specialization. Orton's early work as teacher and observer gave him the broad view. When he first became known to the scientific world as an investigator he was recognized at once as a general practitioner or all-around geologist, and when, in later years, his field was somewhat restricted and he became an expert in a special department, there was no danger that his narrow view would blind him to the recognition of the broader relations.

In somewhat similar way the method and phraseology of his scientific writings were determined by the compound character of his career. As a teacher he was called upon to present the principles of his science to beginners in scientific study; as a lecturer to popular audiences he was accustomed to the communication of scientific ideas in untechnical language; and as executive officer of academy, college and university he had constantly to deal with men of affairs untrained in the technicalities of science. Thus ever in touch with the lay mind he was in no danger from the literary pitfalls which beset the recluse and the specialist. He wrote for the people in language which they could understand, and even when presenting his scientific conclusions to brother geologists he found little need for those technical terms which are so apt to render science unintelligible to the general reader.

The manner of his introduction to the work of scientific investigation had its in-

fluence also on the quality of his work. As most of my audience are well aware, scientific investigation, or the endeavor to understand nature, consists of two parts, observation and theory. We open our eyes to the facts, or phenomena, as they are called, of nature, and make record of what we see, and then we endeavor to explain the phenomena by discovering how they have come to be. We observe and we theorize. But while observation and theory may logically be distinguished, in practice they must be intimately combined or the best results are not secured. There are, indeed, observers who take little cognizance of theory; but the best observers have theory constantly in mind, and through consideration of the relation of their facts to theory have their vision sharpened and their attention guided to those things which are most important. And there are theorists, too, who are indifferent to facts, soaring untrammelled in the realms of imagination and speculation. But the successful theorist tests every hypothesis by scrupulously comparing it with the phenomena to which it pertains, and modifies or rejects it when he discovers a discordance. It is by the observer who is also a theorist, and the theorist who is also an observer, that real progress is achieved.

As a teacher Orton derived from the literature of geology a body of theory which he complemented, so far as practicable, by personal observation of the rocks, minerals and fossils that lay within his reach. Thus he trained himself early to habits of observation, and in all his later work kept in close touch with the phenomena of nature. As an investigator he generalized freely and did not shrink from the propounding of theories, but all his theories were so broadly founded upon, and so faithfully verified by, the phenomena of observation that they came to the world as demonstrations which could not be gainsaid.

This far we have considered only Orton's work in pure science, but his work in applied science was of equal or greater importance, and it was in this field that his personality was most marked. I trust that you will bear with me in another digression at this point, for his life serves to illustrate certain peculiarities of the relation of man to science which are not always kept clearly in view.

It is a matter of common understanding that scientific knowledge, or knowledge of nature, is the foundation of the material progress of the race, but the method through which it serves this purpose is perhaps less broadly understood. Through research the body of 'natural knowledge' has been created and is constantly increased. This body of knowledge is a storehouse from which men may draw that which they find useful, and from which they do, in fact, make drafts at every stage of progress. But the store of knowledge grows quite independently of the drafts which are made upon it. The utility of the individual grains of knowledge is not foreseen, and their accumulation is always much faster than their utilization. So far as we may judge the future by the past, only a small portion of the garnered knowledge will ever find practical application, and thus, from the purely utilitarian standpoint, there is an immense waste of energy in the prosecution of research. This only illustrates the general fact that mankind is a part of nature, for in nature the ways of progress are ever wasteful. The acorn is nature's device to prevent the extermination of the oak, and an oak tree in its long lifetime produces a myriad of fertile acorns, but only one of these, on the average, escapes all the dangers of immaturity so as to develop a perfect tree; the others fail for lack of opportunity, and, so far as the continuance of the species is concerned, are wasted.

The gathering of this great store of nat-

ural knowledge, only part of which can serve the purposes of mankind, is called pure science. The utilization of such portion as may be found available constitutes applied science. If the practical ends of applied science constituted the only motive for labor in pure science, mankind would be appalled and discouraged by the enormity of the waste; but, fortunately for human progress, another motive exists in the love of knowledge for its own sake.

Every activity which is so often repeated as to become habitual affects mental constitution and may result in a corresponding sentiment, appetite or instinct, which in turn becomes a motive for the activity. Take, for example, the fundamental act of eating, which is essential to preservation of life and is common to all animals. There has been developed in connection with it a desire to eat, or appetite, which for most sentient beings is the actual motive, there being no perception of the relation of food to life. Men associated in communities find advantage in the classification and division of labor so that each shall perform some one function for others as well as for himself, being repaid through equivalent service by others. In order to exchange labor, or the products of labor, good faith is necessary, and coöperative living has accordingly developed the sentiment of honesty. Moreover, as industrial organization makes each individual continually work for others more than for himself, there is developed in him a sentiment impelling him to do for others, the sentiment of altruism. Again, the importance of social aggregation in the evolution of all phases of human culture has led to the creation of great nations, and national existence has engendered national sentiment, the sentiment of patriotism, but the masses actuated by patriotism as a motive have little conception of the value of aggregation as a factor in human development.

In a similar way scientific research as an essential to material progress has developed its own sentiment, the scientific sentiment, or the sentiment of acquiring knowledge for its own sake, and this is the motive of pure science. As honesty, altruism and patriotism are sometimes carried to absurd limits, so as even to oppose the ends they normally tend to promote, so the scientific sentiment is liable to perversion; and there are not wanting scientists so devoted to the acquisition of knowledge that they are impatient of its application, and look with disdain on other scientists who strive to discover its uses.

In the application of natural knowledge to human uses material gain is usually in sight, and this supplies a motive so distinct from the unselfish sentiment of science that the same individuals are rarely votaries of both pure and applied science. Taking an illustration from the branch with which I am most familiar, the mining engineers, occupied with the application of geologic knowledge and actuated primarily by the motive of material gain, are a distinct body of men from the geologists proper, occupied with the acquisition of geologic knowledge and actuated primarily by the scientific sentiment. There are, indeed, individuals who perform both functions, but as compared to the general body they are rare exceptions. Such an exception was Edward Orton, and he stands prominent among geologists as one actuated by altruistic motives not only in the acquisition of knowledge but in its application. Selecting, by preference, the geologic problems connected with the useful minerals stored in the strata of his State, he carried his work not merely to the inductions and theories of pure science but to practical utilitarian applications, and these were freely given to the community he served. Through official reports, through the columns of newspapers, and through personal conversation he imparted not only

statistical information and general principles concerning the occurrence of ores and mineral fuels, but practical and timely advice as to their exploitation and conservation. Employed by the people, he labored for the people, and he gave them the bread for which they asked.

Orton's work in geology, so far as it is a matter of record, is largely connected with the survey of this State [Ohio.] For thirty years he was an officer of the State, and though not continuously engaged in its service nor always compensated in money for the work which he performed, it is believed that he devoted more time to its exploration and survey than any other geologist, and that his knowledge of the distribution, qualities and structures of its rocks was correspondingly intimate and comprehensive. His reports are so numerous and extensive and pertain to so wide a range of topics that I shall leave their enumeration to the biographer and bibliographer* and content myself with a simple outline.

An assistant geologist under the directorship of Professor Newberry he began work in 1869 in the southwest quarter of the State, called the Third District, and his labors were confined to this field for a number of years. Gradually, however, they were extended to coal fields farther east, and after the year 1882, when he practically assumed the functions of geologist in chief, the entire State was within his purview. He was also engaged for shorter periods in the investigation of oil and gas fields of Kentucky, Indiana and New York, and he made reports to the United States Geological Survey and to the Eleventh Census of the United States on various economic resources of Ohio and Indiana. His contributions to pure science were in part published by the Geological Society

* A list of scientific papers will appear in volume 11 of the Bulletin of the Geological Society of America.

of America and by various scientific journals.

Among his writings are many discussions of the character, sequence, extent and arrangement of the geologic formations underlying the State, and also of the deposits of drift which mantle the surface. He described in detail the geologic features of many counties, and he worked out and published the structure of most of the coal fields of the State, discussing not only the relations and extent of the seams, but their practical qualities. During the last two decades he gave great attention to the development of petroleum and natural gas, treating the scientific and practical aspects of the Ohio fields with a thoroughness which I believe to be without parallel. At various times he studied and wrote upon the building stones, limestones, iron ores, rock water, gypsum and clays of Ohio and other States, elucidating the geologic relations and usually pointing out also their economic bearings.

From the mass of material thus accessible I select for special mention a single contribution to pure and applied science, choosing the one with which his name is most frequently associated by brethren of the hammer at home and abroad. I refer to his study of the relation of gas, oil and brine in subterranean reservoirs. It was well known that the flow of oil from a well is often preceded or accompanied by the escape of gas; it was known that the life of an oil well was often terminated by the influx of water, and that this water, when derived from the same reservoir as the oil, was highly charged with mineral matter; it was known that the static pressure of natural gas in a well was usually the same for all wells of a group or district, and independent of the altitude of the opening; and partial explanations of these facts had been suggested by various students; but it remained for Orton to formulate a compre-

hensive theory explaining all the phenomena, and then, testing it by comparison with a series of measurements and other observations in the gas and oil fields of northern Ohio and Indiana, to place it on a sure and enduring basis. Like many another result of elaborate and successful investigation, his theory, when stated, appears so simple as to be almost axiomatic, and one is tempted to wonder why the common sense not only of geologists but of all concerned in the development of petroleum and natural gas had previously failed of its attainment; and yet nearly every part of it has been at one time or other the subject of attack and controversy.

Each stratum of porous rock containing a profitable store of oil and gas is sealed above by some impervious layer, so that fluids cannot escape upward, though it may communicate freely with the surface of the ground at a distant point, if only the communication involves an inverted siphon equivalent to the plumber's trap. Under these conditions the stratum constitutes a reservoir in which three fluids arrange themselves according to gravity; gas occupies the pores of the upper part, and is succeeded downward by oil, which in turn rests upon water. If the stratum reaches the surface of the ground at a place lying higher than the reservoir, the water supplied to it by rains exerts a pressure, in accordance with the familiar hydrostatic law, on the water in the reservoir, and this is communicated to the oil and gas. The gas is compressed until its elasticity counterpoises the weight of the column of water. If, now, a well is drilled so as to tap the reservoir at its highest point, gas rushes forth, being forced out by the pressure of the water. If a well reaches the reservoir in the zone occupied by oil, the oil is similarly forced upward, and may be discharged at the surface in case the pressure from the water is sufficient. If a boring taps the reservoir

still lower, it reaches water, which is similarly forced upward and may flow at the surface. The water is always a brine, because, occupying a closed reservoir, it has no circulation and has been dissolving for ages the soluble minerals contained in the rocks; and it is thus contrasted with the potable waters of artesian wells, which contain comparatively little mineral matter, because they are parts of an underground circulation and their sojourn within the rocks is comparatively brief. An ordinary artesian water does not rise in wells everywhere to the same height, the pressure, or head, diminishing as distance increases from the source of supply; but the stagnant brine underlying a body of petroleum is everywhere subject to the same pressure, and will rise to the same height in any well to which it has access. This principle is intimately related to the pressure under which gas escapes from a well and its knowledge has been found of great practical value to the natural gas industry.

It follows from the theory, and it is also a matter of observation, that as the gas in a reservoir is drawn off through wells, the underlying oil and brine rise to take its place, and when the local store of gas has been exhausted, the wells either produce oil or are flooded by brine.

With the demonstration of this theory the earlier idea, that gas was forced outward merely by its own elasticity, and that it was generated in subterranean laboratories from fossil organic matter as rapidly as it escaped, was completely disproved. It became evident that the supply of gas in each reservoir was definitely limited; that if once exhausted, it could never be restored; that economy was required in the use of natural gas, as with any other resource; and that the folly which permitted it to escape freely to the atmosphere was also a crime. That such criminal and disastrous folly was actually perpetrated in

most of the gas fields of northern Ohio and central Indiana was not the fault of Dr. Orton, who early sounded the note of warning, and strenuously combated the infatuation of the well owners.

Of the high esteem in which Orton was held by his colleagues in scientific labor you are already aware. The Geological Society of America, an organization including the leading geologists of the continent, chose him as its president, to serve for the year 1897; the American Association for the Advancement of Science, foremost in importance among American scientific bodies, called him to the chair of its geologic section in 1885, and bestowed its highest office in the last year of his life. Even in his own country he was not without honor.

G. K. GILBERT.

*ADDRESS OF THE PRESIDENT BEFORE THE
AMERICAN SOCIETY OF NATURALISTS.**

BEARING in mind that we have with us this evening representatives of all branches of natural science, it seems better that I should not attempt to give here a sketch of the progress of botany nor discuss the special problems which botanists are trying to solve. Botany is certainly progressing, but progress is not hastened by stopping too frequently to consider just how much progress has been made. As far as questions of botanical research are concerned the past year has not been marked by any startling discovery, but it has been rather a year of transition, and the work done may be expected to bear mature fruit later. The most striking feature of the past year in our own country has been the publication of a remarkably large number of treatises of an educational character in which the results of recent botanical work have been presented in a fresh and attractive form, but this is evidently not an occasion on which

* New Haven, December 28, 1899.

one should speak of their merits or point out their defects.

Instead of calling your attention to any special phase of botany I shall take the liberty of presenting a few considerations suggested by a comparison of the different methods of organization of universities and other scientific establishments in this country and in Europe. Such considerations, although they apply to all advanced studies and research, whether literary or scientific, are not to be considered beyond our province, for in more ways than may at first be supposed there is a community of learning, and any method or organization which genuinely promotes one form of knowledge tends to promote the study of other branches. I say genuinely because I do not believe that a system which professes to encourage the exclusive study of one or a few subjects will in the end be successful.

Although any organization may be better than no organization at all, there is a possibility of pushing organization to an extreme, and, by putting too many wheels into our educational clocks, produce a disastrous amount of friction. Organization should be carried so far that the knowledge which has been acquired slowly and laboriously from experience and research is systematized in such a way that the student may be able to learn all that is possible without loss of time, and the investigator, well informed as to what is already known, be able to take up the thread of the unknown and unravel it to the greatest advantage. When organization goes so far as to dictate just who should do certain things and to prescribe stereotyped ways of work, it is always disastrous. Since a good organization of the forces at our command is probably the most efficient means of securing steady progress in science, an examination of different modes of organization should prove instructive.

Without entering into the futile question

of the relative inherent capacities of the scientific men of different European nations, it is safe to say that we should all agree that, in point of scientific organization, the German universities surpass all others. Probably most of my hearers have, at some time, pursued their studies in Europe, and, if they have attended German universities rather than those of other countries, it was because they were convinced that, however eminent individual professors might be elsewhere, Germany was the place where the university system would enable them to obtain most readily the results of modern science and to prepare themselves for investigation. Although we Americans are supposed to have a sufficiently high opinion of our own abilities and our own institutions, it is certainly true that we are willing to learn from other nations. A considerable portion of the Americans who have studied in Germany have on their return home a feeling that the German university system is better than our own and desire to introduce German methods, and it is not necessary to remind you of the great influence which such a feeling has had on our own universities. Our social and intellectual conditions, however, do not permit us to transform our universities completely into institutions like German universities, and there has grown up with us a system which is peculiarly American, of which the full significance has in an important respect often been overlooked.

When one asks how our universities differ from those in Germany and other European countries, the answer generally given is that students who enter foreign universities have had a more thorough preliminary training than our own; that the instructors, taken as a whole, have a more profound knowledge of their specialties; and that the equipment in the form of libraries, laboratories and museums is more complete than in this country. Were these

the only respects in which our own universities differ from those of Germany, for instance, we might believe that the differences would disappear in the near future. Our preparatory schools, it is claimed, are improving; our university instructors are becoming better equipped for their special work, and, at least as far as natural history is concerned, our libraries and laboratories are numerous and some of them are hardly inferior, for all practical purposes, to those of the best European universities. Were the differences I have mentioned the only ones, we could say with truth that there is no radical difference between our universities and those of Germany, but merely a difference in the comparative development, which time would obliterate. There is, however, another fundamental difference, on which it seems to me too little stress has been laid, a difference which, as far as I can see, tends to become more marked or which, at least, shows no signs of diminution in the near future. I refer to the method of university government. Strange to say, although we are living in a republic, the whole tendency in our colleges and universities is towards a more autocratic form, while in Germany, on the other hand, it is of a more democratic character. In other words, excluding the purely political question of supporting or, at least, of not interfering with the administrative measures of the government in power, the instructing, the learned body, the faculty, has in Germany more power in regard to appointments and the general policy of the university, while with us, the greater power lies with the president and the boards known variously as corporations, trustees and overseers. The German universities have no president, in our sense, but the presiding officer is selected annually from the body of professors in rotation. Nor is there in the English universities any officer corresponding to our college, or university,

president, the chancellorship being rather an honorary position than one of active duties.

The American president, on the other hand, is a true executive of such importance and intrusted with such power that the selection of a proper president is a vital question. If he is capable, the college is successful; if he is incapable, it quickly falls behind. The successful modern president is, furthermore, a very different person from the president of twenty-five or more years ago. Formerly the president was frequently a professor selected for his eminence as a scholar, due regard being paid to his orthodoxy. His position as president did not debar him from continuing to lecture as a professor. The modern president is less frequently selected from the body of professors, and, if so selected, he is chosen not so much on account of his eminence in science or literature as from his presumed ability as an administrator. In becoming president he almost of necessity relinquishes his position as a lecturer. He must above all things be a man of good business head whose previous experience has given him a knowledge of educational methods. It is the president rather than the faculty who, in the opinion of the public, shapes the policy of the American university, for, although, accepting the suggestions of the faculty, he may adopt them as his own policy, he is not under the necessity of doing so, and the skillful president is usually successful in inducing the faculty to recommend the policy which he thinks advisable.

The preponderating influence of the president and financial board as compared with that of the faculty or board of instructors seems to me to be the most striking feature in our American system as compared with the European university system. The system has gradually developed with us from the time when one person combined

the functions of professor and presiding officer. During the last 15 or 20 years the relative importance of the president has been more marked, owing to the fact that by the transformation of the older colleges into universities the amount of administrative work has been greatly increased, and with it has come the increasing necessity of depending more and more on the intelligence and activity of a single mind as supervisor and administrator. Furthermore, the remarkable increase in the number of colleges and universities, none of them with sufficient endowment to provide the elaborate equipment and large body of instructors required in a modern university, has brought about a competition between different institutions, each struggling to outdo the others, so that the college president has been forced to become a 'hustler,' to borrow an expression from the business world, and he is obliged to see that his own institution is not outdone by others in the scramble for private and public money to carry on establishments requiring additional sums for proper endowment. Whether we like it or not, I think it will be admitted that what I have described as peculiarly the American system of university organization is one which we must accept as unavoidable in this country, and there is no probability that the system will be changed essentially in a short time. That being the case, it is our duty to adapt ourselves to it and make the best possible use of it, not expecting that we shall be able to copy closely the systems of other countries except in certain details, which, however, are important.

The great charm of the German university hitherto has been what has been described as the intellectual atmosphere, the prevailing desire of pursuing learning and investigation for their own sake, which, however, does not unfit the Germans for the successful application of science in in-

dustrial and practical fields. We miss in our own universities this universal desire for investigation, which is with us confined to a certain number of persons who are very enthusiastic, to be sure, but are in most cases obliged to justify themselves in the eyes of those who do not understand the value of investigation.

Fashion and the natural tendency to imitate others has, however, done very much for us in recent years in aid of investigation, for, while it may be next to impossible to induce the governing board of a university to spend money on investigation for its own sake, it is a comparatively easy matter to convince them that they must make provision for original work because some other institution has done so and is thereby attracting public attention. If original research can be used as a means for advertising a university, there is no doubt that it will be encouraged, and, fortunately, as it turns out, it is a very good advertisement, even better than victories in athletics. The really successful American universities are those in which the most original work is done. The trouble is that if one looks upon research mainly as an advertising medium, one is apt to demand quantity rather than quality, and to regard the number of papers published annually as the standard of scientific activity.

The pursuit of science for its own sake which characterizes the German universities is one of the results of their form of organization. The faculty, the learned body, shape their own policy more than is the case with us, and they recognize the intrinsic value of research. With us it is necessary, through the president, to convince the corporation and trustees of its value before much can be done, and they, being for the greater part business men or professional men, rather than scholars, are apt to consider that research is valuable only in so far as it is what they call prac-

tical. In this view they undoubtedly represent the American public, and it is from the public that the money must be obtained for carrying on research, either directly from private individuals in the case of endowed universities, or indirectly through the legislatures as representing the public in the case of the State universities. The misfortune is that the word practical means nothing in particular, for even abstract science sooner or later has a practical application, and it often happens that what is supposed to be very practical is merely empiricism which a thorough theoretical study would show to be false.

It would be unjust not to admit that there is something to be said on the side of governing boards in the attitude which they take towards research. Research is expensive, and when the professors ask that it be encouraged that means something more than sympathetic words. It means money or relief from an excessive amount of teaching, which is the same thing as money, for some one must be paid to do the teaching. It can hardly be supposed that the governing boards are really opposed to research, although they at times overrate the value of formal instruction as compared with research. They feel that they have no money to spend, which is, unfortunately, often true, and, on the other hand, they do not understand the absorbing nature of research and the necessity for giving one's close attention to it. So long as research is subordinated to other work it cannot accomplish the best results, and any occupation, whether it be excessive routine work in the way of lectures or laboratory instruction, or whether it be the enforced necessity of going about and talking to private individuals or members of legislatures for the purpose of obtaining money for a proper equipment, stands in the way of, if it does not entirely check, research. In Germany the professors are able to pursue their original work

without feeling that one of their functions is the raising of money for carrying on the work. Unfortunately, in most of our scientific establishments, in speaking of the professors, the double-headed question is not unfrequently asked: What work are they doing and how much money have they raised for the support of their laboratories? For the credit of American science, it is to be hoped that this question will soon be reduced to the simple inquiry as to the work done.

Hitherto I have spoken of American colleges and universities somewhat indiscriminately, since it is not possible to distinguish between them, some colleges not differing essentially from universities, while some so-called universities are not universities in any sense. By whatever name they are called my remarks apply to institutions in which advanced instruction is given, looking ultimately to original research by specially qualified students and by the instructors, and in the same class should be included the better scientific schools, for, although it is hardly proper strictly to compare their organization with that of a German university, many of the anomalous conditions found in our universities and colleges are found also in our scientific schools. I have assumed that all such institutions have the double function of teaching and investigation, a dogmatic view perhaps, but one with which I presume most, if not all, of those present this evening are in sympathy, although there are people, especially some who think that they are very practical, who hold a different opinion.

We believe that the two functions must be combined in a university because we know from experience that, in the cases where instruction is considered to be the sole function, stagnation, not progress, is the result. On the other hand, if research were the sole function of a university, it would be difficult to see where else those desiring to

become investigators could be properly trained. The real question is as to the amount of instruction.

It has been the custom in comparing our universities with those of Germany to lament the absence of uniform standards of admission requirements and of qualifications for higher degrees in this country. If by that is meant that it is to be regretted that our standards are not higher, the lamentation is justified. But if, as some think, what we need is a uniform standard in these respects, to be enforced by agreement of the different universities or initiated by the establishment of a national university, I, for one, am thankful that we have no such uniformity. The present uniformity in Germany is the result of an old civilization, and the prevalence of similar educational and intellectual conditions for many years. In the course of time our educational conditions will become more and more uniform and we may have, perhaps, uniform standards of admission and graduation, but, if so, they will be the results of a natural development, not of prescription. So long as the social and political conditions of the different parts of our country differ as they do, real uniformity in university standards is out of the question. Even in sections of limited area the attempts at enforcing uniformity among the different colleges have at times shown the ease with which rules can be kept in theory and yet broken in practice.

The possibility of establishing a genuine national university superior to all others in equipment and authority seems to most of those interested in educational matters to be remote, but, were it possible to have such a university, one could hardly imagine a greater misfortune to learning in America. One need only glance at the condition of things in Germany and France to recognize the benumbing effect of concentrating in one place, especially if it be the political cap-

ital, the greater portion of the scientific establishments. The wide-spread intellectual activity of Germany is, I think, mainly due to the existence in times past of many scattered universities, some better than others, no one, however, superior to all the rest, but all centers of learning, generous rivals in the promotion of knowledge. Whether under imperial Germany the concentration of resources on fewer universities, with a tendency to still greater concentration hereafter, may not have an unfavorable effect on the nation in the long run, is a question which the future must answer. That the concentration of scientific work and workers in Paris has had an injurious effect on France is evident to the French themselves, and they have in recent years made efforts to strengthen the universities in other parts of France. Our country is so large and so varied in population and occupation that we need many independent centers of learning and numerous universities, zealous in promoting knowledge, but not subordinated to a national university, either directly or indirectly, by the expenditure of national funds on a single institution. Whether such universities should be privately endowed or supported by the States is a question to be settled in each case by the locality and tradition.

If it is true that the promotion of science and learning in a country like ours is best accomplished by the existence of numerous independent universities, there is still a large field of research on which government funds may be legitimately spent. The principle that what can be well done by privately endowed universities, or by those supported by the States, had better be left to them rather than be undertaken by the national government, seems to me to be a sound one and to be in accord with the spirit in which our government was founded. Centralization in science, as in government, may be necessary at times, but is to be

avoided when possible. There must, however, always be questions affecting the national welfare which it is undoubtedly the function of the general government to investigate. The study of contagious diseases of man and animals, involving as it does questions of quarantine and other sanitary regulations, which may affect any or all the States, and the study of plant diseases, however caused, and the means of prevention, are good instances of the kind of work which should be undertaken by the national government, for they are of such eminently practical nature and so general in their application that it is important that the government should have constantly in its service experts capable of studying them and of giving at short notice information that may be needed. The theoretical aspects of the subjects mentioned and the study of certain special cases may profitably be undertaken by private or State institutions, but the resources and authority of the general government are needed for the obtaining and spreading of information and the enforcement of preventive or remedial measures. It is an important duty of our universities and scientific schools to train up a body of young men capable of entering the different governmental bureaus as scientific experts, that is to say in the lower grades, for it is not supposed that without a more or less lengthy active service in the bureaus themselves one would be prepared to fill the higher positions. In Germany there seems to be no difficulty in finding among the graduates of universities and technical schools well-trained young men for the scientific establishments of the government. If things are not in so satisfactory a state here it is due, in part, to the very rapid enlargement of the scope of government work in recent years, and there is no reason to suppose that before long the supply of well-trained young men will not equal the demand.

In my remarks this evening I have felt free to state what, to the best of my knowledge, seems to be the condition of our scientific organization, especially in our universities; but in what I have said I have endeavored merely to describe the situation viewed generally, and, if I have taken this occasion to refer to some points in which our system might be improved, I have done so without reference, either expressed or implied, to any institution or locality, but because I cannot help feeling that a plain statement of certain difficulties from which many, if not most of us, suffer is the first step to be taken if we are to expect improvement. I have described the older German universities as generous rivals in the promotion of knowledge. From conditions beyond our control we are at present in a condition of unrest and feverish ambition, each university striving, on insufficient means, to do all that any other university is doing. When shall we become cool-headed enough to do well and thoroughly what our means permit, and wait patiently for the time when we can expand farther without too great tension or attenuation of the resources now at our command?

W. G. FARLOW.

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INHIBITING ACTION OF OXIDASE UPON
DIASTASE.

IN the disease of the tobacco leaf known as Calico, or Mosaic, the lighter-colored areas are found to contain more starch in the form of granules than do the green areas of the same leaf. This is very peculiar, inasmuch as the chloroplasts of the light-colored areas are evidently in an unhealthy condition.

In an article published in the *Centralblatt für Bakteriologie*, II Abt. Bd. V., No. 22, I have pointed out the fact that these light-colored cells exhibit much more oxidizing activity than do the green cells of the same

leaf. The light-colored areas were found to correspond with the light-colored patches produced by insect punctures, certain fungi, and especially in that group of diseases known as variegation or albinism.

All these cases show a greater amount of oxidizing enzymes (oxidases as well as peroxidases) in the light-colored tissues. Mainly upon this evidence I was obliged in the article mentioned to differ from most other writers on the disease in question, in calling the lighter-colored tissues diseased, and the deep green patches, especially along the veins, healthy. It is true that much tobacco is apparently normally as light colored as the light-colored areas in the diseased leaf, but, on the other hand, there is quite as much which is normally as green all over as the green areas in many of the diseased leaves. It is true that some of the green patches, especially where the light-colored areas are unusually light, are abnormally green. A study of the histology of the diseased leaves has now revealed a histological difference which makes it very clear that the light-colored areas are not normal, and this difference consists in the fact that in badly diseased plants the palisade parenchyma of the light-colored areas is not developed at all. All the tissue between the upper and the lower epidermis consists of a spongy or respiratory parenchyma rather more closely packed than normal. In moderately diseased plants the palisade parenchyma of the light area is greatly modified. Normally the palisade parenchyma cells of a healthy plant are from four to six times as long as broad. In a moderately diseased plant, however, the cells are nearly as broad as they are long, or at most not more than twice as long as broad. As a rule, the modified cells of the leaf pass abruptly into the normal cells of the green area. In a badly diseased leaf simply looking across the surface with the naked eye shows depressions where the

light areas occur, or where the leaf is mostly diseased the dark green patches are raised above the general surface.

The cells of the diseased area also translocate their starch with difficulty, the cells often becoming completely gorged with this material. The examination of the diseased spots early in the morning shows only a small decrease in the starch content of the cells from that present the previous afternoon, while the green, healthy tissues either contain no starch or contain only traces of it. It was thought that possibly the increase of oxidizing enzyme might either inhibit the production of diastase by the cell or inhibit the action of diastase upon starch. In order to settle this point strong solutions of tobacco oxidase were prepared, and after heating some of the solution to the boiling point, thus killing the oxidase, comparisons were made by adding 10 milligrams of taka diastase in solution to each of the tubes of juice to be tested. Equal quantities of freshly prepared potato starch paste were then added to each tube and the tubes kept at 45 degrees Cent. It was found that in the solution without oxidase the starch was completely converted into sugar in thirty minutes, while the solutions in which the oxidase was active only carried the change of the starch to the erythrodextrin stage. The action of the diastase of malt added in solution in the same quantity was somewhat less rapid than that of taka diastase, but the relative effects were exactly the same: the presence of the oxidase in the solution had a marked inhibitory action upon the activity of the diastase.

In these tests the proportion of diastase to oxidase was much greater than occurs even in the diseased cells, so it is likely that the inhibitory action of the oxidase in the cells is much greater than that shown in the tests outside of the cells.

It would seem a warrantable conclusion, therefore, that the tardiness in the trans-

location of starch in the diseased area is to be explained by the abnormal activity of the oxidizing enzymes of these cells, and that the mode of this action is by retarding or weakening the activity of the translocation diastase. This would also help to explain the slower growth of the diseased cells.

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*THE MEXICAN HALL OF THE AMERICAN
MUSEUM OF NATURAL HISTORY.**

WHEN the Europeans first set foot in Mexico, they were met by a numerous people who had become settled into nations, and had developed a civilization which was astounding and incomprehensible to the conquering adventurers. The antiquity of this American civilization was so great, and it was so widely spread over Mexico and Central America, that there still remains a vast accumulation of materials exemplifying the daily life of the people. Hundreds of temples and other large and elaborate structures and sculptures in stone, which were connected with the ceremonials of an all-pervading religion fostered and maintained by priests and rulers, stand as monuments of this ancient civilization.

Several distinct phases of this culture resulted from modifications by different tribes with distinct languages and customs. In Mexico proper the most powerful nation was that of the Nahuas, commonly known as the Aztecs. Their principal seat was in the Valley of Mexico, but by migrations and conquests they left their imprint in various parts of Mexico and Central America. The other prominent cultures of this ancient time in Mexico are attributed to the Tarascans in the States of Michoacan and Jalisco, the Zapotecs and the Mixtecs in the State of Oaxaca,

* Opened on December 12, 1899.

and the Totonacs in the State of Vera Cruz. The great southern development, in many ways the highest phase of this American civilization, is attributed to the Mayas. It extended from the State of Chiapas on the north, through Yucatan and Guatemala, to northern Honduras, where in the Copan Valley it probably reached its highest development.

From the time of the conquest by Cortes this ancient civilization on the American Continent has been a wonder and a mystery. Some of the Spanish priests and native writers following the conquest left accounts of the people and their customs, from which the student of to-day is obtaining important information; but it is only during the present century that serious research has been directed to the study of this remarkable phase of American archaeology. The publication, by Stephens in 1841, of the volumes containing illustrations by Catherwood of the ruins in Chiapas, Yucatan and Central America, first aroused attention among English-speaking peoples to the ruins of these ancient cities of America with their strange sculptures. From that time this interest has been increasing, and during the last decade systematic exploration and research have led to many important discoveries, the beginnings of definite knowledge concerning the origin and development of this past American civilization.

It was in furtherance of this research that the American Museum secured from the Government of Mexico the right to explore the ancient ruins in that country. It was for this object that Mr. Lorillard provided the means for Charnay's expedition to Yucatan and other parts of Mexico. It was this incentive that led Mr. Thompson to take up his abode in Yucatan, and that induced Dr. and Mrs. Le Plongeon to pass years of arduous labor in that country. For this purpose the Duke of Loubat sent

Dr. Seler on a special expedition to Mexico and Central America; and to this end Mr. Maudslay, of England, has devoted much of his time and private means. For the same purpose Messrs. Bowditch, Salisbury and others have for several years given their generous support to the Peabody Museum of Harvard University, that explorations might be carried on in Yucatan, Guatemala and Honduras.

All this research has made it possible to secure such an exhibit as is now installed in the Mexican Hall of the American Museum of Natural History; but it is due to the intelligent interest and liberality of the Duke of Loubat that the Museum has been able to bring together this large and important collection, which is soon to be exhibited for the instruction of the public.

The originals of the great sculptures in stone, of which facsimile casts are here presented, are, with the exception of a few specimens in other museums, still buried in tropical jungles or amid the ruins of ancient temples. The general labels on each of the larger specimens, and the illustrated labels in the frames near them, give information relating to each of these sculptures (known as monoliths, stelæ, idols and altars) from the prehistoric ruins of Quirigua in Guatemala and of Copan in Honduras. These are all monuments of the Maya culture, and on most of them will be seen groups or columns of hieroglyphs, the deciphering of which is one of the most important researches in American archæology. The sculptures at the farther part of the hall are from Mexico, and belong mostly to the Nahuatl culture. The dark color of the casts shows that the originals are of a different kind of stone from that used in Quirigua and Copan.

On entering the hall, the most conspicuous object on the left is the so-called 'Great Turtle of Quirigua.' To the right is a large 'idol' known as the 'Dwarf,' because

it is the smallest of the stelæ standing amid the ruins of Quirigua. A cast of the largest of these monoliths, standing twenty-five feet above ground, is too high for this hall. It is exhibited in the hall below, where from the gallery a study can be made of the upper portions of the sculptures.

On the right of the hall is a restoration of the sanctuary of the 'Temple of the Cross,' showing the position of the bas-relief known as the 'Tablet of the Cross,' with the officiating priests and the hieroglyphic inscription. In a frame on the side of this reconstruction is an illustrated label explanatory of this temple at Palenque. In the table-case near by are several pieces showing hieroglyphics and figures made in stucco, which was widely used. The great 'Calendar Stone,' the most remarkable of Mexican sculptures, is shown on the south wall. On the walls and screens on the north side of the hall are many fine bas-reliefs from ruins in Guatemala, Honduras, Palenque and Yucatan. Over the northern case at the east end of the hall is a group of slabs from Palenque, upon which are many columns of hieroglyphs. Over the adjoining case, and on the south wall near by, are casts of slabs from the ruins of Chichen Itza in Yucatan. Here are also the sculptured stone posts of a doorway upon which rests a carved wooden lintel. To the right of this is shown the sculptured wall of a portion of a room in a temple at Chichen Itza, on which are many human figures and a feathered serpent. There is evidence that this and many of the other sculptures were formerly painted in several colors, of which red, yellow and blue predominated. The statue of Chac-Mool, found by Dr. and Mrs. Le Plongeon at Chichen Itza, is an instance where the colors were still preserved. The cast of this reclining statue was colored by Mrs. Le Plongeon in exact copy of the original when found.

In case A are the Tarascan terra-cotta figures and stone sculptures secured by the Lumholtz expedition.

In case B, on the east end of the hall, are original sculptures in stone from Copan and Yucatan.

In case N is a collection, also from the Lumholtz expedition of pottery from the ruins of Casas Grandes, illustrating a culture approaching that of the ancient Pueblo people of Arizona and New Mexico.

In three other cases at this end of the hall, and several cases at the opposite end, are various collections, including jadeite ornaments, copper implements and ornaments, carved stone yokes, a large terra-cotta human figure, and pottery vessels of many forms, all illustrative of the culture of several of the ancient Mexican peoples.

Cases C and D contain the collections made by Dr. Seler in Mexico and Guatemala, and presented by the Duke of Loubat. In another case are terra-cotta figures of great value found over a tomb in a mound at Xoxo by Mr. Saville of the Museum expedition. A cast of the inscribed stone lintel of the door, and many vessels found with skeletons in this tomb, are most interesting objects.

The ancient Mexicans and Mayas had many manuscripts or codices consisting of picture-writing and of hieroglyphs. These were on prepared deer-skin or on native paper made of maguey fiber and coated with a kind of white cement. Several of these codices were sent to Europe soon after the Conquest, and others have since been found. They are of the utmost importance; but, being few in number and widely scattered, they were of little use until reproduced in facsimile, so that every student could have access to them for comparative study. In the two cases in the center of the hall, and in the frame over them, are a number of copies of these important records. For these the Museum is indebted

to the Duke of Loubat, at whose personal expense several of these manuscripts have been reproduced in facsimile.

There is thus brought together in this Mexican Hall of the Museum the most important collection in existence for the study of the ancient civilization of Mexico and Central America.

F. W. PUTNAM.

HARVARD UNIVERSITY.

*CORRESPONDENCE RELATING TO COLLECTIONS OF VERTEBRATE FOSSILS.
MADE BY THE LATE PROFESSOR O. C. MARSH.*

THE following copies of letters have been sent to the Editor of SCIENCE by Hon. Charles D. Walcott, Director of the United States Geological Survey.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C., May 5, 1891.

THE DIRECTOR,
U. S. GEOLOGICAL SURVEY,
WASHINGTON, D. C.

SIR:

* * * * *

The large collections of vertebrate remains in the charge of Professor O. C. Marsh, at New Haven, Connecticut, are kept in the fire-proof Peabody Museum building, and in a large storage shed adjoining. The method of recording is somewhat different from the other collections, but it is very thorough and complete.

In the field where the specimens are collected a label is placed inside of each box as it is packed. On this U. S. Geological Survey is printed in bold letters. On the outside of the box U. S. Geological Survey is plainly marked before the boxes are shipped. When received at Professor Marsh's laboratory in New Haven, a record is made of each box received and to each an entry number is assigned. This

number is at once recorded on the box and, when the box is opened, on the label and on each and every specimen contained in the box with an oil paint. When it is necessary to remove a number in working out specimens from the matrix, the number is copied on some other portion of the rock or directly on the fossil before it is removed from the other portion. This number is the record of locality, stratigraphic position, and history of discovery; additional information is added from time to time under the number in the record book. This includes the identification of the genus and species and any data that may be of importance. The removing of the number from any specimen at once deprives it largely of scientific value, and it is to the interest of every one working on the collection to have it kept intact. When the final work is done and the specimen is identified, labeled with its name and ready for exhibition, it then receives a catalogue number. The old number, however, still follows it in the record of the latter.

The record of the entry number is kept in duplicate and Professor Marsh is now preparing another duplicate set to be filed with the Geological Survey. This record will show the number of boxes of specimens received, from 1882 to 1891. The laboratories and storage rooms provided by the Yale University Museum represent a floor space of over 9000 square feet, for which the Geological Survey does not pay rent. In addition to the collection at New Haven, there are seventy boxes of vertebrate fossils stored in the Armory building in Washington, and a collection is now being prepared for exhibition in the United States National Museum.

* * * * *

Respectfully yours,

(Signed) CHAS. D. WALCOTT,
Paleontologist.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
December 8, 1899.

PROFESSOR S. P. LANGLEY,
SECRETARY, SMITHSONIAN INSTITUTION,
WASHINGTON, D. C.

DEAR SIR: I have the honor to state that all the vertebrate collections of the late Professor O. C. Marsh, belonging to the Government, have been shipped from New Haven, Conn., and are now transferred to the custody of the U. S. National Museum, subject only to the use of such material as may be necessary for study and illustration in the completion of the monographs that were in course of preparation by Professor Marsh at the time of his death.

From a statement submitted by Mr. F. A. Lucas, who had charge of the packing of the collections, it appears that there were 1200 trays (20-26 inches) of specimens, 200 unopened boxes as received from the field, 30 blocks and 90 prepared specimens. To ship this material required 592 boxes, forming five car loads, having an aggregate weight of 160,000 pounds. To this there should be added two car loads containing 211 boxes received from Professor Marsh on deposit in 1891 and 1898.

The actual number of specimens represented in this collection cannot be stated. They range in size from minute teeth of fossil mammals to individual specimens weighing from 500 to 2000 pounds each. The collections are rich in large Dinosauria, especially in examples of *Triceratops* and *Stegosaurus*, while the series of *Titanotherium* skulls is one of the best, if not the best, in existence. It contains 50 or more complete examples cleaned, and a number in the rough, besides many hundred bones.

Among the specimens transferred are the types of 40 or more species, including Dinosaurs and Jurassic, Cretaceous and Terti-

ary mammals. Among the types are the following:

DINOSAURS.

Diplodocus longus.
Labrosaurus ferox.
Camptosaurus nanus.
Triceratops sulcatus.
Triceratops californis.
Triceratops obtusa.
Pleurocælus nanus.
Ceratops nasicornis.
Ceratops montanus.
Ceratops alticornis.

CROCODYLES.

Rhytidodon rostratus.

SNAKES.

Coniophis precedens.

JURASSIC MAMMALS.

Paurodon valens.
Manacodon rarus.
Enneodon crassus.
Enneodon affinis.
Laodon venustus.

CRETACEOUS MAMMALS.

Priconodon crassus.
Cimolodon agilis.
Telacodon priestans.
Oracodon cenulus.
Allacodon pumilis.
Batodon tenuis.
Allacodon fortis.

I requested Mr. Lucas to make an appraisal of the value of the specimens. He states that this is a very difficult thing to do, but that many of the specimens could not be replaced, and some specimens, like the skulls of the *Triceratops*, should be worth at least \$5,000 each, while crania of *Titanotherium* are worth from \$50 to \$250 each, according to perfection, and that an estimate of the value of the entire collection will be upwards of \$150,000. This is, of course, tentative, as some of the material has not been worked out at all, and some not removed from the boxes in which it was shipped from the field.

It is to be recalled that these collections were made by Professor Marsh during his connection with the Geological Survey, from 1882 to 1892 inclusive; that prior to his connection with the Survey he made large collections, including the toothed birds, the *Dinocerata*, *Brontosaurus*, many Dinosaurs, and the best *Titanotherium* yet discovered. He also purchased numerous collections after the stopping of allotments for his work in 1892. These collections were transferred to Yale University some time prior to his death.

As there has been considerable comment in relation to this matter, I send you a

copy of a report on the examination of the collections under Professor Marsh's charge, made by me to the Director of the Geological Survey, in 1892.

I twice visited New Haven while the collections were being packed, and am fully convinced that all material belonging to the Government has been transferred to Washington. Mr. Lucas reports that the Trustees of the Peabody Museum in New Haven gave him every facility for packing the collections, and that the records were so complete that no difficulties arose in determining those specimens which belonged to the Government and those which were the property of the Peabody Museum.

The transfer of these great collections to Washington without the loss of any material, either through imperfect recording or through misunderstanding as to the ownership of specimens, reflects the greatest credit on the business-like methods and the integrity of Professor Marsh. The addition of the material to the National Museum places it in the front rank among museums in its collection of vertebrate fossils. It is necessary that some gaps in the collections be filled, and I sincerely trust it will be possible for the Museum to do this at an early date.

Yours respectfully,

(Signed) CHAS. D. WALCOTT,
 Director.

INCLOSURE.

SMITHSONIAN INSTITUTION,
 December 22, 1899.

DEAR SIR: I take great pleasure in acknowledging the receipt of your letter of the eighth instant, advising me that you have transferred to the National Museum all the vertebrate fossils collected by the late Professor O. C. Marsh belonging to the United States Government, subject only to the condition that such material as is required may be used for study and illustra-

tion in completing the monographs which were in preparation by Professor Marsh at the time of his death.

The addition of this immense collection of most important American fossil remains to the treasures already assembled in the National Museum will, I am sure, afford the greatest satisfaction to all workers in the field of paleontology both at home and abroad, and you will permit me to add a personal word in appreciation of your untiring efforts to facilitate in every way possible the great task connected with the removal of the collection from New Haven to Washington.

During the coming year I expect to have two preparators engaged in working out of the matrix specimens still uncleaned, and confidently hope that it may be possible in a few years to have the entire collection made available for study and a selected series for public exhibition. From this latter series the public will be able to form a correct idea as to the number, variety and great size of these wonderful extinct creatures of the western country, and will undoubtedly be impressed with the extent and importance of the work of the paleontological divisions of the Geological Survey and the marvelous industry and intelligence displayed by Professor Marsh in bringing together this great collection.

Yours respectfully,

(Signed) S. P. LANGLEY,
Secretary.

THE HONORABLE CHARLES D. WALCOTT,
DIRECTOR UNITED STATES GEOLOGICAL SURVEY,
WASHINGTON, D. C.

SCIENTIFIC BOOKS.

On the Building and Ornamental Stones of Wisconsin. By E. R. BUCKLEY, Ph.D. Bull. No. IV. Economic Series No. 2. Wisconsin Geological and Natural History Survey. 1898.

The first attempt at a systematic investigation of the building stones of the United States was

undertaken by Dr. G. W. Hawes under the auspices of the 10th Census. With the untimely death of Dr. Hawes the completion of the work fell into the hands of others, none of whom were experienced and some of whom had received no training such as should fit them for special investigations of this nature. Under such conditions it is not strange that the printed volume* should have been somewhat disappointing. Nevertheless it furnished a beginning and at least served to show what was not known on the subject.

This was followed in 1887 by Merrill's Handbook of the Collections of Building and Ornamental Stones in the United States National Museum,† which was based upon the Census Collections; and later by Stones for Building and Decoration (Wiley & Sons, New York), the first edition of which appeared in 1891 and the last in 1897. The above constitute the only comprehensive systematic treatises compiled with reference to the United States that have thus far appeared.

Several excellent special and local reports have, however, been made, among which should be mentioned Winchell's report on the building stone of Minnesota,‡ and the reports of Smock on those of New York;§ Williams on the Syenites of Arkansas;|| Hopkins on the Marbles of Arkansas,¶ the Brownstones of Pennsylvania,** and the Carboniferous Sandstones of Western Indiana;†† Macallie on the Marbles of Georgia;‡‡ H. F. Bain on the

* Special Report on Petroleum, Coke and Building Stone, Vol. X., Rept. 10th Census, 1884.

† Rep. U. S. National Museum, 1886, pp. 275-648.

‡ Vol. I., Final Report on the Geology and Natural History of Minnesota, 1884, pp. 142-194.

§ Bulls. No. 3, New York State Museum, 1888, and Vol. III., No. 10, 1890.

|| Ann. Rep. Geological Survey of Arkansas, 1890, Vol. II.

¶ Ann. Rep. Geological Survey of Arkansas, Vol. IV., 1890 (1893).

** The Building Materials of Pennsylvania, I. Brownstones, Appendix to Ann. Rep. of the Penna. State College for 1896, pp. 122.

†† 20 Ann. Rep. Dept. of Geology and Natural Resources of Indiana, 1896, pp. 186-325.

‡‡ Bull. No. 1, of the Geol. Survey of Georgia, 90 pp. 1894.

Stones of Iowa;* and lastly that of Mathews and Merrill on those of Maryland.†

The volume noted at the head of this article, bearing the date 1898 but seemingly not issued till the latter part of 1899, is the latest and most pretentious of them all, with the exception of that of the 10th Census, comprising some 566 pages with 49 full-page plates and four figures in the text. The plates include a colored geological map of the State and seven others in which the natural colors and textures of the stone are approximately reproduced by lithographic processes, the remainder being half-tone reproductions of quarry views and stone structures. The work is divided into three parts: (1) Demand, Uses and Properties of Building and Ornamental Stones; (2) Geological History of Wisconsin and Description of Areas and Quarries, and (3) Appendix, On The Composition and Kind of Stones.

The chief interest and value of the work center in part II. (pp. 75-357 inclusive), since the only information heretofore available on these points has been that given in the 10th Census report above referred to, and Merrill's *Stones for Building and Decoration*. The work has apparently been well and thoroughly done. By far the most interesting stones described, and the ones which on account of color may hope to find a market beyond the State limits, are the Montello, Waupaca, Waushara and Wausau granites, and the Berlin rhyolites. The brown sandstones of the Lake Superior region should, in the Middle and Western States, fill the place of the red brown Triassic stones in the Eastern. In nearly every instance samples of the stone described have been submitted to laboratory tests and their crushing strength, absorptive and general weathering properties ascertained, so far as is possible by these methods. It is a trifle discouraging to note that it was considered necessary to go to the expense and trouble of making over 100 tests of crushing strength on rocks which even a casual inspection would have shown to be sufficiently strong for all practical purposes. Concerning the value of such tests the present writer has expressed himself elsewhere.

* 8th Ann. Rep. Geol. Survey of Iowa, 1898.

† Vol. II., Rep. State Geol. Survey, 1899, pp. 241.

If one were disposed to be critical he might call attention to the carelessness manifested in some of the very few references given, and to the tendency to ignore the work of others, Professor A. D. Conover's paper of fifteen quarto pages in the report of the 10th Census, not even being mentioned. There is, further, a non-convincing air of freshness in the explanation put forward on p. 383, to account for the unfavorable action of freezing temperatures on newly quarried material.

Colored illustrations add to the attractiveness of the book, but are to some extent misleading, giving a perfection of surface and brightness of color, which the materials themselves do not possess. This is particularly the case with the red and pink granites. Plate 34 of the Lake Superior sandstone is also disappointing, as, indeed, is plate 45 of a similar subject in the 10th Census report, and plate 27 in that of the Maryland Survey. The attempt is instructive, as showing the relative merits of lithographic reproductions from colored drawings, as compared with the tricolor photographic process used in the Maryland report, the advantage however, being wholly with the latter.

Very poor taste has been shown in the arrangement of the views of quarries and structures in the half-tone plates, and particularly those numbered 4, 17, 24, 42 and 47. A picture which does not illustrate some definite feature is out of place in a work of this nature, and, if of value, it should be so oriented on the page as to be easy of reference. The fad for placing the several views on one page at varying angles with one another is not readily excusable, and in this particular case the effect is very inartistic as well.

There is much to be commended in the work, but it is not too much to say that it would be more useful if of half the size. The amount of paper involved is out of all proportion to the information contained therein.

GEORGE P. MERRILL.

Untersuchungen über die Vermehrung der Laubmoose durch Brutorgane und Stecklinge. By DR. CARL CORRENS, a. ö. Professor der Botanik in Tübingen. Jena, Gustav Fischer. 1899. Pp. xxiv + 472. 187 figs. Price, 15 M.

This extensive and very detailed work brings together a large number of observations on the vegetative reproduction of the true mosses by means of cuttings and of gemmæ, by which are meant those structures which serve, like the spores, to disseminate the plant over more or less extended distances. Interesting matters of biological interest are suggested to the mind by the analogies existing between these organs and seeds, but these will be referred to later on in the review.

The text is divided into two parts. A first or special part consists of a descriptive treatment of gemmæ and cuttings and of their behavior, arranged along taxonomic lines. The general part which follows treats of the morphological and anatomical structure of the organs under consideration, of their germination and of the conditions necessary for their occurrence and growth.

The large number of observations brought together in the special part prevent any adequate presentation in the limits of a review, so that it is possible only to point out that the great variety of asexual reproductive bodies which are found in the mosses may be reduced to a few types, viz.: the stem, leaf and protonema types. The stem type is found in those plants in which the stem is transversely breakable at intervals throughout its length, or merely at its base or apex. In this type the leaves may be reduced, resulting in bulbil formation, or the stem, to form brood-buds.

The leaf type occurs in forms in which the leaf is broken off as a whole and germinates, or is separable into fragments, each acting similarly.

True brood-bodies, so called by the author, arise only from the protonema in the wide sense, including that produced from the stem (rhizoids) and the chloronema.

The facts in this part which will interest especially, perhaps, the general botanist, are those relating to the methods by which these brood-organs are separated from the parent plant. This separation is accomplished either by the tearing of certain cells (rhexolytic) or by a splitting apart of cells by the behavior of the inner lamella (schizolytic). The rhexolytic process may be provided for by a special zone

of cells or by a single cell, according to the complexity of the structure. The cell appointed for the sacrifice is called by Professor Correns a 'tmema' a term which constitutes a very picturesque addition to botanical terminology, the more so when one contemplates its compounds 'dolichotmema,' 'brachytmema' and the hybrid 'strecktmema.'

In the special part are first discussed the morphology and phylogeny of the brood-organs. Here the author advances the notion that the aerial part of the moss plant (*i. e.*, the stem and leaf) is phylogenetically older than the protonema and that it results from a reduction of the moss stem, though not, says the author, in the sense of Sachs and others, according to whom the oblique position of the transverse walls of the protonema is an indication that its terminal cell is the homologue of the apical cell of the moss stem, an explanation which, it will be conceded quite generally, is forced. According to the author's view, the forms such as *Ephemerum* and *Buxbaumia* are reduced and not primitive as to their shoot characters. This statement is probably correct in itself with regard to *Buxbaumia*, high authority to the contrary notwithstanding; though it is difficult to see why this fact may not very naturally and easily harmonize with the opinion of Goebel by supposing that a secondary reduction, correlated perhaps with the more pronounced development of the sporogonium, has taken place. This position is strengthened by the indubitable fact that analogous reduction has taken place in the sporophyte of some of the Spermatophyta.

Following is a discussion of the structure and development of brood-organs. A circle of interest centers in the paragraph in which it is pointed out that the nematogonial cells (the initial cells which give rise to protonemal structures) preserve their embryonic peculiarities, and regards this as an especially good example of the 'continuity of the germ plasm.'

The special adaptations for the abscission of brood-organs have already been referred to. It may be added that active loosening of the brood-bodies is of very restricted occurrence. In the vast majority of cases the breaking away is passive, depending on the impact of air, water and animals. The same end is held by some

observers to be attained through water absorption or drying out, and purely hygroscopic movements. Dissemination may occur by means of air and water currents, and a quite well established case is recorded in which Thysanura were responsible for carrying the brood-bodies of *Aulacomnium* and *Androgynum*. The projection of the parts bearing brood-organs above the general levels of the moss-turf is interpreted as an adaptation for dissemination through such animal forms. Hook-like organs occur (*Ephemeropsis* and *Bryum bulbilosum*), which are subject to similar teleological interpretation, though one with difficulty escapes the conviction that the point is somewhat far-fetched. Mucilaginous outer membranes, which insure adhesion to animal forms, are also present in some kinds.

Of the remaining matters perhaps the most important to mention here are the attempt to determine whether correlation occurs between the habit of producing gemmæ and the conditions under which the plants live, and to estimate the taxonomic value of the organs in question.

The typography and numerous illustrations are up to a high standard, but do no more than justice to the thorough work of the author. A full index of generic and specific names extends greatly the usefulness of the volume, which will be of very great value to those botanists who are interested in the biological matters relating to the mosses, but whose studies have not been directed to them in a taxonomic way. It will also serve a good purpose in enabling the student who may be contemplating research in these lines to orientate himself historically. This will be facilitated also by a very complete bibliography.

FRANCIS E. LLOYD.

FROM a systematic standpoint this work is of great value to American students, for of the 110 species described, 52 are known to occur in this country, and 108 out of the 187 figures refer to them. Systematic books have overlooked asexual methods of reproduction except in such cases as *Georgia pellucida*, *Aulacomnium palustre*, *Tortula papillosa*, and a few others where the means were so conspicuous as to defy ignorance; hence it will be a surprise to learn that *Dicra-*

num scoparium, *Funaria hygrometrica*, *Bryum argenteum* and *Dicranella heteromalla*, though commonly found fruiting, have also methods of propagation. Those species which are conspicuous for their brittle leaves are many of them rare in fruit, forming new plants from the fragments of the leaves, but an interesting addition to the list having this method is *Anomodon tristis*, which thus far is unknown in fruit. The 'Conservæ Orthotrichæ,' those brown septate bodies which occur on the leaves of various species of *Orthotrichum* and *Grimmia*, have long been familiar, but few students have realized why so many species of *Campylopus*, *Tortula*, *Bryum* and *Plagiothecium* were more often found sterile than fertile, nor how they reproduced in spite of this fact. Climates where sexual reproduction is difficult cause a greater development of other methods, and dioicous species are more apt to develop asexual methods than monoicous ones. An artificial key is given by which the asexually propagative species may be classified according to the modifications of the stem, leaves and protonema; it will be useful in encouraging the study and collection of such species as have been ignored or overlooked on account of lack of fruit. The work has paralleled that of F. De Forest Heald, published in the *Botanical Gazette* for 1898, but it is more extensive, and the author claims to have found that *Bryum an-notinum*, *Pleuridium nitidum bulbilifera* and *Lep-tobryum pyriforme* are identical. There is a similar identity between *Pottia riparia* Austin, which antedates *Leptodontium Canadense* Kindb. and *Trichostomum Warnstorffii* Limpr., all of which propagate by clusters of septate propagulae borne on the paraphyses, seemingly replacing the archegonia, hence all but *Pottia riparia* have thus far been only found sterile. Under whatever genus the species is recognized, that of Austin has priority, a fact to which I have already called attention.

E. G. BRITTON.

N. Y. BOTANICAL GARDENS,
BRONX PARK.

The Physical Nature of the Child and how to Study it. By STUART H. ROWE, PH.D., Supervising Principal of the Lovell District, New Haven, Conn.; formerly Professor of

Pedagogy and Director of Practice in the State Normal School at Mankato, Minnesota. New York, The Macmillan Co.; London, Macmillan & Co., Ltd. 1899. Price, \$1.00.

The strictly scientific contribution of this book is rather small, but its practical value is likely to prove very great. It is a *résumé* of many of the important results of recent studies in child psychology and school hygiene, based largely upon such authorities as the *American Journal of Psychology*, the *Pedagogical Seminary*, the *Child Study Monthly*, the *Educational Review*, and the standard books and papers on child study and school hygiene. From a scientific point of view the special contribution of the book consists in the fact that it gives the reaction of a practical teacher to the more theoretical conclusions of psychologists and students of hygiene.

Among the topics considered are the senses, motor ability, nervousness, fatigue, habits of posture, habits of movement, growth and adolescence, and school and home conditions. The more common and simple tests of the senses, of motor ability, nervousness and fatigue are given; and the commonplace teachings in regard to education and health that result from psychological study are presented in a way that is likely to appeal to teachers. The keynote of the book is stated by the author as implied in two fundamental principles of education: "One of these is that action is the first law of growth; the other, that individuals vary enormously in their capabilities for different kinds of mental and physical action."

Very few direct references to literature are made in the body of the book, and the query naturally arises whether in a work so largely based on recent studies in psychology and hygiene even the popular demand for a clean page justifies the omission of explicit reference to authorities. To the scientific student, such a lack is often exasperating, and in this case only partially atoned for by the blanket acknowledgment in the selected bibliography at the end; and some ambitious teachers may wish to know, for example, who besides the author have used the tests for hearing mentioned in chapter 3; upon the results of whose investigations of fatigue are based the suggestions (pages 80-81)

'which we may accept as practically proved'; how the author knows (p. 130) that children grow more rapidly in summer than in winter; and where Eulenberg's table of scoliosis among school children (given on p. 154) can be found. The need of such references to authority is emphasized, for example, by recent investigations upon fatigue which cast discredit upon Griesbach's method, and in many places throughout the book the weight of the author's statements would be increased by direct citation of authority.

WM. H. BURNHAM.

SOUTH AMERICAN LANGUAGES.

Der Sprachstoff der brasilianischen Grammatik des Luis Figueira nach der Ausgabe von 1687. Von JULIUS PLATZMANN. Leipzig, B. G. Teubner. 1899. Octavo. LIV., 247.

Der Sprachstoff der Guaranischen Grammatik des Antonio Ruiz übersetzt und hier und da erläutert von JULIUS PLATZMANN. Leipzig, B. G. Teubner. 1898. XX., 261. Octavo.

Chilidúgu. Lachrymæ salutare opera Bernardi Havestadt. Editionem novam immutatam curavit DR. JULIUS PLATZMANN. Lipsiae, Teubner. 1898. Pp. 78.

Los Indios Matacos y su lengua por Juan Pelleschi, con introduccion por S. S. LAFONE QUEVEDO. Dos mapas. Buenos Aires. 1897. Pp. 246.

The above mentioned publications are not facsimilary editions of authors such as Dr. Platzmann is in the habit of issuing, but explanations in the form of translations and commentaries of vocables and grammatic forms recorded in books now difficult to obtain. Guaraní and Tupi are dialects of the same family very closely related, and at the time these missionaries were composing their works Guaraní was heard not only along the eastern border of Peru, but also along the La Plata, in Paraguay and on the coast of Brazil.

According to the most reliable sources Luis Figueira was born in the Portuguese province of Alemtejo in 1575, entered the seminary of Evora in 1592 and went over to Brazil in 1602. He settled in Maranhão in 1607 to found missions for the conversion of the natives, and by the year 1615 the knowledge he had acquired of Guaraní enabled him to compose his 'Arte

de Grammatica' of the 'Brazilian' or Guarani language. He was on the return trip to the mother country, Portugal, when he became shipwrecked at the mouth of the Amazonas, at Marajó Island, attacked by the Aroan savages and put to death on July 6, 1638.

The main part of Platzmann's volume is followed by a series of 1991 Guarani terms of Figueira translated and commented upon in German. In reading this list we often wish to have the original of the *Arte* in hand for reference.

In the preface Platzmann discusses the phonetics of that language and the characters used by the *Padre* to express certain sounds. There are also literary sketches on previous and recent Portuguese authors on Brazil, its Indians and their languages, and on the area in which Tupi is spoken at present.

Another apostle of the Roman Catholic faith among the Brazilian tribes was Antonio Ruiz de Montoya. He was born in Lima, 1583, and died there in 1652; therefore he can be considered as an American-born missionary. His earliest work appears to have been the *Tesoro*, a Guarani-Spanish dictionary of 814 pages, which saw the light in Madrid, 1639. This was followed next year by the *Arte* or grammar of Guarani, the *Vocabulario* and the *Catecismo*; this last was reprinted by Platzmann in 1876. The words of the language are presented, analyzed and translated in 2236 items. This part of the volume is instructive, but the part of Platzmann's preface in which he compares Guarani radicals with those of European languages contains too many fanciful ideas to meet general approval.

Having previously republished Bernard Havestadt's 'Tractatus de lingua Chilensi,' in two volumes, Dr. Platzmann was informed that his publications of Havestadt's 'Opera' were not complete without his 'Lachrymæ salutaris.' So he set himself to commit this Latin religious poem, although it has nothing to do with Indian philology, to press. It is written in fine trochaic verses, which were in vogue in his time for church poetry.

Juan Pelleschi is a civil engineer, who wrote his book in Italian and had it translated in Spanish. He treats of the customs and man-

ners of the Matacos or Mataguayos, a roving people inhabiting the Gran Chaco, not in a strictly scientific manner, but in a colloquial way. This may be said also of his treatment of the Mataco language, which is identified with the Tonocoté. We find no paradigms of nouns or verbs, no rules, exercises, etc., but the character of this tongue is developed at length and in a general way without any strict plan or method. Of the two maps the first is a reproduction of an ancient map and exhibits in an excellent manner the early distribution of tribes on the Gran Chaco. A Spanish-Mataco and a Mataco-Spanish vocabulary concludes the publication.

ALBERT S. GATSCHET.

SOCIETIES AND ACADEMIES.

THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

At the 508th meeting of the Society, held on December 9th, at the Cosmos Club, biographical sketches of Mr. Edward Goodfellow and of George Brown Goode, were read; the former by Mr. H. G. Ogden, and the latter by Mr. Cyrus Allen. The regular papers of the evening were by Mr. E. D. Preston on the 'Language of Hawaii,' by Mr. F. H. Bigelow on 'Results of Recent Exploration of the Upper Atmosphere,' and by Mr. G. W. Littlehales on 'Possible Methods of Measuring the Resultant of the Centrifugal and Gravitational Forces on the Ocean.' The first paper dealt with the Polynesian languages in general and the Hawaiian in particular, from the standpoint of comparative philology. Similar constructions were followed out in the Oceanic and Indo-European tongues, and points of contact were noted between modern Hawaiian, on the one hand, and French, German, Spanish, Italian and English, on the other. In the last paper the author, after recounting the trials that were made by Mascart, nearly twenty years ago, to determine the variation of the force of gravity from place to place by means of a siphon barometer whose short arm was closed and contained a certain quantity of gas, referred to the experiments that have lately been made by Mohn of Christiania, according to a method that was reported to the U. S. Coast and Geodetic Survey, in 1890, by

Assistant Superintendent Tittmann, with a view to finding the gravitational correction in mercurial barometric readings by comparing the atmospheric pressure as indicated by the mercurial column with the true atmospheric pressure as deduced from the temperature of unconfined steam. He then proceeded to relate his own considerations and experiments concerning the possibility, in times of exceptional calm at sea, of using the Electric Clepsydra for the measurement of the relative quantities of mercury discharged in equal intervals of time at different places from an orifice in the bottom of a vessel of comparatively large cross-section, and also concerning the possibility of ascertaining the changing relation, with change of place between a given mass, and its weight, by the use of a modification of the standard aneroid barometer in which the vacuum chamber has been replaced by a heavy mass.

E. D. PRESTON,
Secretary.

ANTHROPOLOGICAL SOCIETY OF WASHINGTON.

THE 296th regular meeting of the Society was held Tuesday evening, December 5, 1899.

Miss Alice C. Fletcher read a paper on 'The Building of the Earth Lodge' describing its minute structure, purpose and variety.

Dr. Washington Matthews read a paper on 'The Earth-Lodge in Art,' in which he stated that the earth-lodge was the most commodious aboriginal structure existing in America north of New Mexico. Henry in 1807 measured one in the old Mandau Village at Knife River which was 90 feet in diameter. Thousands of such lodges, inhabited by tribes of widely different stocks, existed in the Mississippi Valley at the time of the Columbian discovery; their remains are scattered from North Dakota to Louisiana and from Western Kansas to Eastern Tennessee.

Dr. Matthews stated that the embellishments in works of ethnography and travel were often false, and tended to lead the student astray rather than to aid him. He gave a number of general instances of false illustration in ethnography, but spoke chiefly of the misleading pictures of the earth-lodge published in various works. He exhibited pictures taken from the

works of Gass, Catlin, De Smet and Morgan, and compared them with photographs of the real lodge. The most faithful pictures of the lodge not photographic were those of Mr. Bodmer, the artist who accompanied the Prince of Méd.

Mr. Jas. Mooney read a paper entitled 'The Earth-Lodge in the Gulf States.'

J. H. McCORMICK,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON.

AT the 314th meeting on December 16th, Lester F. Ward spoke of 'the Fossil Forests of Arizona,' saying that they were of Mesozoic age, the strata containing the petrified trunks ranging from just above the Permian up to and including the Upper Trias; the formation extended northwards into Utah. The territory in which the petrified forest lay was in Apache Co., east of Holbrook, but while the trunks were found over a very considerable tract the best portion of the 'Forest' was embraced in an area about eight miles square. In some portions of this the petrified logs lay much more thickly than they could have stood when living. In fact these trees did not lie where they had grown, but had been transported thither in Mesozoic time by strong and swift currents and had then been rapidly buried in sand. The trees were completely silicified and so well preserved that the microscopic structure could be clearly made out, showing that they were related to the Araucarian Pine of the Southern Hemisphere; hence the genus had been named *Araucari oxylon*. The speaker stated that his recent visit to the petrified forest was the result of a request from the General Land Office for a report as to the desirability of reserving the most interesting portion as a national park, a memorial to Congress to that effect having passed the Legislature in 1895. Owing to the visits of tourists, the more beautiful specimens were being steadily carried away and destroyed, while many car loads had been removed to be cut, polished and made into ornaments. Owing to the extreme hardness of the silicified trunks, it had been proposed to utilize them in the manufacture of a substitute for emery, and a crushing plant had actually been erected, al-

though never operated, owing to the development of the corundum industry in Canada.

Ex-Governor W. A. Richards, Assistant Commissioner of the General Land Office, who was present and was invited to speak, said that the Land Office was in earnest in this matter and was glad to have a truly scientific report on the subject. He stated that a very large amount of the material was now being worked up in this country into articles to be sold at the coming Paris Exposition.

F. A. Lucas described 'Blue Fox Trapping on the Pribilofs,' saying, that Mr. James Judge, Treasury agent on St. George Island, had experimented extensively in the feeding and trapping of foxes, and had devised methods by which they could be readily taken alive, so that the females could be liberated, as well as a certain proportion of the males, the other males being killed. The entire paper will appear in SCIENCE.

M. B. WAITE described a 'Soil Inoculation Experiment with Soy Beans,' in testing the effect of imported Japanese soil on the Soy bean. This plant is a native of Japan and in that country forms root tubercles abundantly. In this country the plants commonly do not form root tubercles, for the reason that the necessary germs do not exist in American soils. The Soy bean is thus unable to gather free nitrogen after the manner of other Leguminosæ.

Soil was imported from a Soy bean field in Japan and sown in small quantities in the drill with the seed. The experiment was tried on a newly cleared piece of sandy land poor in combined nitrogen, and the results were quite striking. The plants in the control rows at harvest time plainly showed nitrogen starvation. In the rows inoculated with Japanese soil the plants were larger, leafier and darker green in color. They showed the effects of nitrogen fertilization. On examining the roots they were found to be well supplied with the nitrogen, gathering tubercles, while the check plants had few or none. The comparative weight of the treated and untreated portions was as 14 to 8 in favor of the treated plants.

O. F. COOK,
Secretary.

ONONDAGA ACADEMY OF SCIENCE.

THE November meeting of the Academy was addressed by Dr. J. M. Clarke, the New York State paleontologist. He gave briefly a history of the work accomplished by the geological survey of the State from its inception in 1842 to the present time, and explained in detail the new system of nomenclature proposed for the State, giving reasons for accepting the same. The latter part of the address was devoted to an account of the transitional fauna of the Portage and Chemung formations.

At the meeting of the Geological Section Mr. C. E. Wheelock read a paper on 'The Marls of Onondaga County.' He showed that the principal deposit crossed the county just north of its center and in an east and west direction, corresponding quite closely with the southern extent of the extinct Lake Iroquois. The beds in the western part of the county were studied in detail, and would seem to bear out the theory that there had occurred several oscillations of the lake shore. Excavations within the limits of Syracuse seem to corroborate the same theory. Mr. Wheelock believed that this marl deposit was cotemporaneous in formation with the existence of Lake Iroquois. The few isolated and small deposits in other parts of the county he held to be of different and probably more recent formation.

At the December meeting Dr. W. M. Beauchamp spoke on local archæology. He said that the village sites and their approximate dates of occupation could be traced by the relics found on the various sites. As the Onondagas occupied usually only one village, their migrations are more easily traced than tribes consisting of several villages. The occurrence of implements of walrus tusks, and also a peculiar variety of stone knife, prove beyond reasonable doubt that the Eskimos were earlier inhabitants, even if only temporary, than the Indians.

Dr. W. G. Hinsdale described the character of relics found on local sites, speaking more particularly of the harpoons, barbed fish-hooks and other polished bone implements. Grooved axes are only rarely found in this section, and implements are seldom found buried with the skeletons unearthed.

H. W. BRITCHER,
Corresponding Secretary.

THE PHILOSOPHICAL SOCIETY OF THE UNIVERSITY OF VIRGINIA.

THE regular monthly meetings of this society have begun. At the first meeting of the present session the following officers were elected for the current year:

President, Dr. C. W. Kent; Vice-president, Professor W. H. Echols; Secretary, Dr. W. J. Humphreys.

After the election of officers, Professor Ormond Stone delivered the customary address of the retiring president. His subject was *The Moon*. His address, supplemented by many excellent photographs, was a clear presentation of the more recent theories in regard to the markings on the moon's surface, and probable past and future history of the moon's relation to the earth.

The second meeting, December 8th, was devoted to meteors. Professor Ormond Stone gave a brief outline of the preparations made under the auspices of the Leander McCormick observatory for studying the Leonid meteors. These included, among other things, six photographic stations on a north and south line about forty miles in length.

Dr. M. W. Humphreys explained his methods of making and recording eye-observations of meteors, and called attention to several very singular meteors—about half a dozen in all—seen on the nights of November 14th and 15th. These were all red and moved in wavy lines, the amplitudes being approximately one degree. It was admitted that this might be an optical illusion, but if so, not peculiar to the observer, as in the case of the most conspicuous meteor of this type the same phenomenon was noted by at least one other member—a young lady—of the party.

Dr. W. A. Lambeth gave an account of a shower of meteors he saw in November, 1892, in North Carolina. He said it was about eleven o'clock at night and that they appeared far too rapidly to allow even a guess at the number—that they presented the appearance of a veritable rain of fire, so much so that for a time the engineer of the train he was on refused to run his engine, and that the negroes, as in 1833, indulged in song and supplication, believing firmly that the end of the world had come.

Mr. J. A. Lyon gave a short history of the Leonid meteors, covering a period of about one thousand years.

Dr. W. J. Humphreys, described the photographs obtained, all of which, with possibly one exception, failed to show meteor trails. Several practical points were learned, however, and these were stated in view of the fact that renewed efforts will be made next year to photographically determine the radiant and the height of the atmosphere.

At the close of the meeting Professor F. L. O. Wadsworth, director of the Allegheny Observatory, showed to those interested a curved star negative of Orion and adjacent regions which he had recently taken. This remarkable negative, due to the combined skill of Wadsworth and Brashear, has, in excellent definition, more than one thousand square degrees, and shows, according to their estimation, more than 50,000 measurable stars.

W. J. HUMPHREYS,
Secretary.

ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

THE regular autumn meeting of the society was held in the rooms of the Commercial Club, in Birmingham, on the afternoon of November 16, 1899.

Mr. T. H. Aldrich, ex-president of the society, in the chair. Present, Messrs. J. A. Montgomery, B. B. Ross, Col. Horn, E. A. Smith and representatives of the press. The reading of the minutes of the last meeting (annual) was dispensed with, as the proceedings of this meeting had already been printed and distributed. The Secretary made the statement that on the occasion of the spring meeting so few members and officers were present that it was decided not to have a meeting, notwithstanding the fact that Dr. Ross was present with a paper and Mr. James Bowron had consented to talk to the Society about Cuba.

After the regular routine, Dr. Ross gave an abstract of his paper on 'The Fertilizer Resources and Fertilizer Industries in Alabama.' This valuable paper will be printed in full in the Proceedings. Dr. Ross also exhibited to the members a number of samples of phosphate rock collected recently by him in the vicinity of Athens,

in Limestone County. The samples analyzed by him contained from 15 to 20 per cent. of phosphoric acid up to 36 or 37 per cent.; and he also showed a sample of superphosphate prepared by him from this rock, the manufactured article containing 13.15 per cent. water—soluble, 0.15 per cent. reverted, and 1.24 per cent. insoluble; total 14.9 per cent. phosphate.

In the discussion which followed, Mr. Aldrich said that a fertilizer manufactory in Meridian was using lignite from the Burning Cut in Sumter County, Ala., as a filler, and that it contained 1.5 to 2.0 per cent. ammonia. Mr. Aldrich had formerly sold from the Blocton mines several hundred tons of coal slack, to a Shreveport company, for the same uses. He also mentioned the fact that he had recently examined a lignite occurring in Mississippi, 17 miles west of Starkville, which had only 4.5 per cent. of ash and which made a very good coke.

Dr. Smith then read a preliminary report of the mineral statistics of Alabama for the second and third quarters of the current year; after which, there being no other business before the meeting, it was adjourned *sine die*.

EUGENE A. SMITH,
Secretary.

DISCUSSION AND CORRESPONDENCE.

DR. WILSON'S REPLY TO HIS CRITICS.

I CONSIDER it complimentary to an author that his works should be criticised. It shows that they are worthy of attention and consideration. The friendly criticism in *SCIENCE*, December 22d, of my address delivered in Columbus last August, before the Section of Anthropology of the A. A. A. S., appears under such misapprehension as seems to require a word of explanation. That address, as its title indicates, was 'A History of the Beginnings of the Science of Prehistoric Archaeology.' It was a *résumé* or description of the discoveries made, or alleged to have been made, which led to the foundation of the science, and a statement of the theories advanced for its establishment. This being its purpose, it was proper that I should treat of all its topics, and this without binding me to an approval of them. I was recording a history of the science, not necessarily maintaining the

truth of all the theories advanced by its founders. The friend who wrote the criticism seems not to have recognized the difference. He makes strenuous opposition to the classifications of the science as set forth in my address; but none of them were mine. They had been made in Europe many years since, were applicable to that country, and most of them are still in use there. In such a history as I was writing it would have been highly objectionable for me to have omitted them; and so with most of the other points in the criticism referred to.

THOMAS WILSON.

NOTES ON INORGANIC CHEMISTRY.

AN important practical application of the liquefaction of hydrogen is that of the production of high vacua, as described by Dewar in the *Proceedings* of the Royal Society. At the boiling point of hydrogen the vapor tension of air is less than a millionth of an atmosphere, hence when to vacuum tubes for the spectroscopic examination of gases is attached a temporary tube immersed in liquid hydrogen, the solidification of the air in the tube produces a very high vacuum. In this way the more volatile constituents of atmosphere become concentrated in the tube, and in numerous tests the presence of neon and of helium was revealed in a volume of air less than 50 cc. Some tubes showed a hydrogen spectrum, but others did not, so that the question as to whether free hydrogen exists in the atmosphere cannot be considered as settled.

A LATER number of the *Proceedings* contains a paper by T. G. Bonney on the parent-rock of the South African diamonds. The 'blue ground' of the Newlands mines, which are forty miles northwest of Kimberley, contains rounded boulders of eclogite, and in this eclogite are occasional colorless octahedra of diamond, apparently as an original constituent. As the eclogite boulders are water-worn, it follows that the 'blue ground' is not of igneous origin, but it is true breccia produced by the destruction of various rocks, one of which—the eclogite—has contributed the diamonds to the mixture.

THE analysis of a sample of Egyptian porcelain from Memphis is published by Le Chatelier

in the *Comptes Rendus*. The composition is found to be wholly different from that of Chinese porcelain, and hence it would appear that the manufacture of true porcelain was known to the ancient Egyptians. The duplication of this Egyptian porcelain would require 40 parts blue glass, 50 parts fine sand, and 5 parts white clay.

LE CHATELIER has also examined statuettes from Egyptian tombs which were supposed by Salvétat to be carved from a natural grit and then glazed with a sodium-calcium-copper silicate. It appears, however, that the statuettes from several different localities consist chiefly of fine grains of quartz sand, with a little clay as a binding material. The glaze is a mixture of sand with a sodium-copper silicate.

THE effect of sulfur, especially as pyrites, in coal when used as a fuel is discussed by Wilhelm Thörner in the *Chemiker-Zeitung*. With such a fuel, not only sulfur dioxide, but also sulfuric acid will be present in the combustion products. Since at least a portion of this sulfuric acid will be deposited upon the boiler walls, tubes, etc., it is necessary that these should be cleaned frequently. The more moisture present, the greater the corrosive action of the acid. If lime is mixed with the coal, the formation or at any rate the deposition of the acid is in large part prevented. The author suggests the use of briquettes made of an intimate mixture of coal with a little lime. With these not only can fine coal screenings, slack, etc., be used, but sulfuric acid corrosion may be practically avoided.

J. L. H.

CURRENT NOTES ON PHYSIOGRAPHY.

IN resuming the preparation of these notes after an interruption of a year and a half, it will not be possible to mention all the physiographic essays published in the interval, but the effort will be made to give account of the more important ones in which the readers of *SCIENCE* may be interested, as well as to review current publications.

GLACIAL SCULPTURE IN WESTERN NEW YORK.

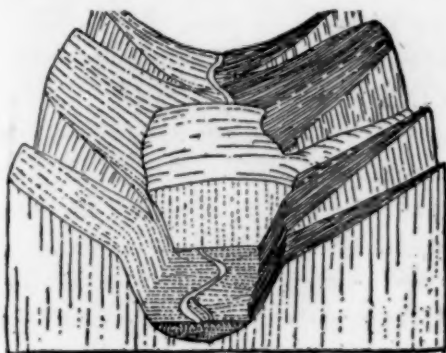
GILBERT concludes that the Niagara limestone upland in western New York is chiefly a

product of pre-glacial erosion, but that its relief has been increased by the greater glacial erosion of the lowland underlain by weaker shales on the north, and that its northward-facing escarpment has been modified in detail by glacial action. Where the escarpment faces northwesterly, so that the ice sheet moved about parallel to its front, the outline has been smoothed; where it faces northeasterly, against the ice motion, preglacial irregularities are intensified by glacial scouring. The plain of Medina shale bordering Lake Ontario, and now overspread with drift and lacustrine strata, has a broadly furrowed rock floor, with troughs parallel to the ice motion: here the minimum estimate of the general reduction of the surface by glacial erosion is set at 40 or 50 feet, 10 or 20 times its measure on the limestone upland (*Bull. Geol. Soc. Amer.*, X., 1899, 121-130).

GLACIATED VALLEYS.

THE most original physiographic essay presented to the recent International Geographical Congress at Berlin was one by Penck on the over-deepened valleys of the Alps. Not only where large lakes occur near the margin of the mountains, but far inward along the larger rivers, the main valley floors are deepened below the level of the side valley floors and the discordance thus indicated is ascribed to the stronger glacial erosion in the main than in the side valleys. The side streams plunge down into the main valley as waterfalls. This discordance of valley floors at first seems exceptional, characterizing valleys of glacial erosion but not of river erosion: but it was well shown that there is no such failure of analogy. A river of water moves nimbly; its cross section is small and its channel is a small part of its valley; the river bed is usually hidden, and hence, as main and side streams have the same surface level at their junction, we do not ordinarily notice that the bed of the main river channel is deeper than that of a side stream, although this relation must be recognized as soon as attention is turned towards it. A river of ice moves slowly; its cross section is large and its channel is a large part of its valley; ancient glacial channels are now habitually laid bare, and the discordance between the beds of

the main and the tributary channels becomes very striking, while we lose sight of the accordance that must have prevailed in the confluent



surfaces of the main glacier and its tributaries. The river channel as well as the glacial channel is U-shaped, but the abandoned glacial channel is so large that it often gives name to the valley in whose bottom it is eroded. The accompanying diagram roughly presents the form of an Alpine valley in preglacial (background), glacial (middleground), and postglacial (foreground) time.

THE heavy glaciation of valleys eroded in the massive gabbros of Skye has produced the following features, as noted by Harker (*Geol. Mag.*, London, 1899, 196-'99). The cross-section of the valleys is U-shaped, especially in their upper part. The head of the valley expands in a corrie (cirque or amphitheatre) whose floor is often a rock-basin holding a tarn. In longitudinal profile, the floor of a valley often consists of two or three stretches of relatively gentle slope (or even of basin-form) separated by relatively sudden descents. Tributary valleys mouth at a considerably higher level than the floor of the main valley. McGee's paper on 'Glacial Cañons' (*Journ. Geol.*, II., 1894, 350-364), referred to by Harker, may be read to advantage in this connection.

It is noteworthy that the discordance of side and main valleys, emphasized by Penck as a characteristic of glacial action, and clearly recognized by McGee and Harker, has been mentioned in but few essays on glacial erosion; yet it can hardly be doubted that such discordance is one of the most striking features of strongly glaciated mountain regions.

ANCIENT VALLEYS OF NORTHEASTERN GERMANY.

THE origin of many broad valleys in northeastern Germany, as determined by ancient rivers flowing westward, marginal to the retreating ice-sheet of the last glacial period, has lately been restated by Keilhac (*Verh. Gesellsch. Erdk.*, Berlin, XXVI., 1899, 129-139, map), with fuller detail than was given in the earlier explanations by Berendt and Girard. Five important valley courses are traced, exterior to five morainic belts; the southernmost connects the Oder at Breslau with the Elbe above Magdeburg; the northernmost led the Oder from Stettin northwest to Ribnitz and south again from Lübeck to the Elbe at Lauenburg. Lakes are indicated by horizontal shore-terraces at certain depressed areas along the valley courses, where the present northward discharge was ice-barred. The ancient ice-margin valleys owe their considerable breadth to the large volume of the rivers that were then supplied by melting ice on the north as well as by rainfall on the south. The rivers of to-day follow the ancient marginal valleys for moderate distances only, and then turn northward through depressions that were opened to them as the ice melted back; sometimes again turning westward for a stretch along the next marginal valley that is encountered. Thus sub-rectangular bends to the right and the left are systematically repeated seven times by the Oder, between Breslau and Stettin.

W. M. DAVIS.

ZOOLOGICAL NOTES.

MR. C. W. ANDREWS, in a recently issued part (Vol. XV., part 3), of the Transactions of the Zoological Society of London, describes at length and figures the skull and portions of the skeleton of *Phororhacos inflatus*, one of the gigantic extinct Patagonian birds. In discussing the relationship of the genus, which is put among the *Gruiformes*, Mr. Andrews shows a decided leaning toward *Cariama*, saying that the relations of the one toward the other are much the same as those of the extinct *Glyptodon* and *Panoethus* towards existing armadillos. Mr. Andrews will be glad to know that among the material obtained for Princeton University by

Mr. J. B. Hatcher, is a small species of *Phororhacos*, or some closely allied genus, in which the sternum is preserved, that this sternum is slightly keeled, and, although no critical comparisons have been made, that the general aspect of the sternum is like that of *Cariama* or *Gypoggeranus*.
F. A. L.

THE MALARIA EXPEDITION TO WEST AFRICA.

MAJOR RONALD ROSS, the lecturer to the Liverpool School of Tropical Diseases, who recently headed the malaria mission to Sierra Leone, delivered an address on December 27th at Liverpool, on the invitation of the African trade section of the Liverpool Chamber of Commerce. His subject was 'The Recent Medical Expedition to West Africa.' According to the *London Times* Major Ross said that politics and science were culminating in two movements of high importance. In politics the Great Powers, tired of self-development, were endeavoring to extend their possessions and civilization all over the world; while in science they had created what was perhaps the most fundamentally important of all knowledge—the experimental science of disease. He believed that in the coming century the success of Imperialism would depend largely upon success with the microscope. Our possessions in Africa were battle grounds between Englishmen and king malaria; they were conquests maintained only at the sacrifice of hecatombs of our countrymen. Malarial fever was perhaps the most important of the diseases of the tropics. For a long time they could obtain no accurate knowledge as to how the disease was produced, but in the last two years they had ascertained definitely at least one mode of infection. They knew for certain that malarial fever was often, perhaps always, caused by the bite of the species of gnat or mosquito called anopheles. The object of the expedition from the Liverpool School of Tropical diseases was to ascertain whether there was any chance of exterminating the anopheles from a given malarious area. It was not the immediate purpose, as some supposed, to banish malaria then and there from the whole continent of Africa. They wished to inquire what could be done in

two or three square miles. They selected Free Town, Sierra Leone, for the investigation, and reached there last August. After describing Free town, Major Ross said that the mission set themselves to work at once on the lines of the recent investigations in India and Italy. In a few days they found numbers of the anopheles, and in a few days more they discovered the germs of malaria actually within those insects. They knew then to an absolute certainty that the anopheles of Sierra Leone were responsible at least for a large part of the fever there. The next thing was to ascertain how they bred. Those very dangerous insects bred in small pools or puddles of a certain kind easy to detect when one had once seen them. They made a map of those pools and carefully studied the habits of the insects' larvæ. The conclusion they unanimously came to was that it would probably be an easy and inexpensive matter to rid the town almost entirely of the anopheles either by destroying the larvæ in the puddles or, better still, by draining away the puddles altogether.

Comparing the general mode of life of Europeans in Sierra Leone and India, Major Ross said that, though Sierra Leone was scarcely more fatal to Europeans than some parts of India, it was certainly much more unhealthy than the large majority of Indian towns and cantonments were. He confessed that after a service of many years in India and Burma he was much struck with a certain negligence in respect to some matters in Africa. In India Englishmen had learned how best to live in tropical countries. They had certain fixed institutions which they seldom did without. He referred to the commodious bungalow, with its large compound, the punkah, and the mosquito netting on the beds. There was no doubt all those were of great assistance, but in Sierra Leone he was astonished to find none of those things, at least in general use. Instead of there being a separate European quarter on the highest ground available and consisting of well-built houses each in the midst of an open garden, most Europeans in Freetown occupied poor wooden structures quite unfit for English people in that pestiferous climate, crowded together and mingled with the houses of the towns-

people (who had not the same reason to dread the malaria), and in the very lowest, dampest and hottest part of the town. The Governments and the great commercial houses who sent *employés* to the tropics and paid their expenses—especially their funeral expenses, which were considerably larger than the mere cost of the hearse—should have something to say on the matter. The nation had not paid sufficient attention to the shocking mortality in its tropical possessions. They shuddered to hear of a few guinea-pigs being inoculated with disease in the laboratory, but looked on with indifference at the infection by natural means of thousands of their countrymen and of millions of our colored subjects in the tropics. They spent floods of money in the tropics on what was called sanitation and maintaining costly medical service, but such expenditure was more or less perfunctory; it was part of the Budgets, and it was allocated without much intelligence, and he feared, largely wasted. Fifty years ago a new parasite called the *ankylostoma duodenale* was discovered. It was now known, chiefly as the result of investigation by private persons, to cause an immense amount of sickness and mortality among our colored subjects. Although the presence of the parasite could easily be detected by the microscope, its name hardly found a place in our statistics of disease. A few years ago Giles studied the mode in which it gained an entry into our bodies. Since then no one had repeated his observations or taken the slightest interest in them. It had not been thought worth while to check the ravages of that disease. Again, some years ago a parasite was found which might perhaps cause that terrible and widespread disease, dysentery. No attempt had been made by Englishmen to clear up that important point; and the life-history of the parasite which was studied years ago by Cunningham seemed to have been completely forgotten. Twenty years ago Manson ascertained that the parasite which caused elephantiasis was carried by the mosquito. Until last year not a single person had made any adequate attempt to verify his work—much less to act upon it for the prevention of the disease. In India alone the mortality ascribed to fever was five million persons annually.

Besides the mortality vast tracts of fertile possessions were rendered uninhabitable by this disease. Twenty years ago the parasite which caused the disease was found, but not a microscope or pen was used by Englishmen for seven years. During those seven years 35 million persons died from fever in India alone. Then a single Englishman, Vandyke Carter, took up Laveran's discovery. He was now dead. For that and other noble work he received no reward. Not another Englishman moved in the matter for another seven years, lazy, indifferent, and imbecile scepticism holding the ground. Then a few young countrymen of ours commenced to study the subject, years after other great nations had been attacking it with vigor, and now they did find medical men and others who paid some attention to it in the British dominions. Now there was an awakening everywhere. The Royal Society itself, assisted by Mr. Chamberlain and the Colonial Office, had taken up the matter with energy. The tropical schools of London and Liverpool had been founded by leading citizens, and scientific missions were being sent to different parts of the world. He had spoken that day in the hope of increasing sympathy in the great cause. A thousandth part of the energy now spent on numberless philanthropic schemes in Great Britain was likely at that moment to produce a thousand times as much fruit if properly expended in the cause of imperial sanitation. They had much reason to hope that in a year or two they would not only have a complete knowledge of how malaria was produced, but would foresee a cheap and practical mode of prevention.

NAVY REPORT ON WIRELESS TELEGRAPHY.

THE U. S. Navy Board has reported on the Marconi system of wireless telegraphy as follows: It is well adapted for use in squadron signaling under conditions of rain, fog, darkness and motion of speed. Wind, rain, fog, and other conditions of weather do not affect the transmission through space, but dampness may reduce the range, rapidity and accuracy by impairing the insulation of the aerial wire and the instruments. Darkness has no effect.

We have no data as to the effects of rolling and pitching, but excessive vibration at high speed apparently produced no bad effect on the instruments, and we believe the working of the system would be very little affected by the motion of the ship. The accuracy is good within the working ranges. Cipher and important signals may be repeated back to the sending station, if necessary, to insure absolute accuracy. When ships are close together (less than 400 yards) adjustments easily made of the instruments are necessary. The greatest distance that messages were exchanged with the station at Navesink was 16.5 miles. This distance was exceeded considerably during the yacht races, when a more efficient set of instruments was installed there. The best location of instruments would be below, well protected, in easy communication with the commanding officer. The spark of the sending coil or of a considerable leak, due to faulty insulation of the sending wire, would be sufficient to ignite an inflammable mixture of gas or other easily lighted matter, but with the direct lead (through air space, if possible) and the high insulation necessary for good work, no danger of fire need be apprehended.

When two transmitters are sending at the same time, all the receiving wires within range receive the impulses from transmitters, and the tapes, although unreadable, show unmistakably that such double sending is taking place. In every case, under a great number of varied conditions, the attempted interference was complete. Mr. Marconi, although he stated to the Board before these attempts were made that he could prevent interference, never explained how nor made any attempt to demonstrate that it could be done. Between large ships (heights of masts 130 and 140 feet) and a torpedo boat (height of mast 45 feet), across open water, signals can be read up to seven miles on the torpedo boat and eighty-five miles on the ship. Communication might be interrupted altogether when tall buildings of iron framing intervene. The rapidity is not greater than twelve words per minute for skilled operators. The shock from the sending coil of wire may be quite severe and even dangerous to a person with a weak heart. No fatal accidents have been re-

corded. The liability to accident from lightning has not been ascertained. The sending apparatus and wire would injuriously affect the compass if placed near it. The exact distance is not known and should be determined by experiment. The system is adapted for use on all vessels of the navy, including torpedo boats and small vessels, as patrols, scouts and despatch boats, but it is impracticable in a small boat. For landing parties the only feasible method of use would be to erect a pole on shore and then communicate with the ship. The system could be adapted to the telegraphic determination of differences of longitude in surveying. The Board respectfully recommends that the system be given a trial in the navy.

SCIENTIFIC NOTES AND NEWS.

WE record with much regret the death of Dr. Elliott Coues, the eminent naturalist, on December 25th, in his 57th year.

A MEMORIAL meeting in honor of the late Daniel G. Brinton will be held in Philadelphia on January 16th, under the auspices of the American Philosophical Society, and with the coöperation of some twenty-four societies. A portrait of Dr. Brinton, a memorial medal and a set of his works will be presented to the Philosophical Society.

PROFESSOR E. B. WILSON, of Columbia University, has been elected president of the American Society of Naturalists, in succession to Professor W. G. Farlow, of Harvard University.

DR. WILLIAM MCMURTRIE, of New York City, has been elected president of the American Chemical Society, in succession to Professor Edward W. Morley.

THE New Year's honors annually conferred in Great Britain include a peerage for Sir John Lubbock, a knighthood for Dr. T. Lauder Brunton, the physiologist, and a K. C. B. for Captain W. de W. Abney, the physicist, assistant Secretary of the Science and Art Department.

A MOVEMENT has been started in Baltimore to pay some special tribute to President Daniel Coit Gilman of Johns Hopkins University, in

honor of the twenty-fifth anniversary of his connection with the University, which occurred on December 31st.

PROFESSOR C. H. EIGENMANN, director of the Indiana University Biological Station, since its establishment, has severed his connection with the Station, and Dr. R. E. Lyons, professor of chemistry, has been appointed as his successor.

PROFESSOR R. W. WOOD of the University of Wisconsin, has accepted an invitation to lecture before the Royal Photographic Society, London, and will leave New York early in January to be absent about six weeks.

PROFESSOR WILLIAM JAMES, of Harvard University, and Professor G. T. Ladd, of Yale University, have been elected delegates from the American Psychological Association to the International Congress of Psychology meeting next year at Paris.

DR. J. W. GREGORY, of the Natural History Museum, South Kensington, has been appointed to the chair of geology in the University of Melbourne, vacant by the death of Sir. J. M'Coy. It is an open secret that Dr. Gregory applied for the post because the trustees of the British Museum refused to recommend him for the position of a first-class assistant, while they at the same time checked the flow of promotion by retaining Henry Woodward as head of the Geological Section of the Museum after the time for his retirement under the age limit. Dr. Gregory will receive four times the salary at Melbourne that he has been receiving at the British Museum, and will have excellent opportunities for research in Victoria. It appears, however, that the trustees of the British Museum have made a serious mistake in refusing to promote from a second-class assistantship a naturalist whose work as explorer and scientific investigator has already won him distinction, and whose services to the Museum during the past twelve years have been most important.

MR. JAMES LYMAN WHITNEY, who for over thirty years has been connected with the Boston Public Library, has been elected librarian in the place made vacant by the removal of Mr. Herbert Putnam to the National Library, Washington. Mr. Whitney is a brother of the late Josiah D. Whitney, professor of geology at

Harvard University, and of the late William Dwight Whitney, of Yale University.

A CABLEGRAM from London announces the death of Sir James Paget, the distinguished surgeon. He was born at Great Yarmouth, January 11, 1814, being the son of a merchant of that city. In 1836 he became a member of the Royal College of Surgeons, and seven years later, after he had made a reputation by some novel and brilliant operations, he was made an Honorary Fellow of the Institution. Among his works are the 'Pathological Catalogue of the Museum of the College of Surgeons,' 'Report of the Results of the Use of the Microscope,' published in 1842, and 'Lectures on Surgical Pathology,' published in 1853, 1863 and 1868. He was also an extensive contributor to the 'Transactions' of the Royal Society, of which he was a Fellow. In 1875 he was elected President of the Royal College of Surgeons, and from 1884 to 1895 he was Vice-Chancellor of the University of London. He was created a Baronet in August, 1871.

THE following have been elected officers of the Society for Plant Morphology and Physiology for the coming year: *President*, Dr. D. P. Penhallow, McGill University, Montreal; *First Vice-President*, Dr. Roland Thaxter, Harvard; *Second Vice-President*, Dr. Erwin F. Smith, Washington, D. C.; *Secretary*, Dr. W. F. Ganong, Northampton, Mass.

THE officers of the American Psychological Association for the ensuing year are: *President*, Professor Joseph Jastrow of the University of Wisconsin; *Secretary*, Dr. Livingston Farrand of Columbia University; *Council*, Professors Ladd, Bryan, Gardiner, Cattell, Delabarre and Kirschmann.

THE members of the American Society of Naturalists voted to invite the members of the American Society, at present in session at Chicago, to constitute the Western branch of the American Society of Naturalists.

THE Society of Gymnasium directors, which met in New Haven last week, will hereafter be affiliated with the societies meeting with the Naturalists. The question of uniting with the Anthropological Section of the American Association was referred to a committee.

A JOINT meeting of the Philadelphia County Medical Society, and the Pennsylvania Society for the Prevention of Tuberculosis will be held at the New Century Club on Wednesday, January 10th. Prominent speakers, both medical and lay, will take part in the discussion. Among the speakers are Dr. Otis, of Boston, Dr. Osler, of Baltimore, and Judge Ashman, of Philadelphia.

THE post of assistant physician in the government Hospital for the Insane with a salary of \$1200 will be filled by Civil Service examination on February 6th and 7th.

THE Göttingen Academy of Sciences offers a prize of 1000 Marks for a mathematical paper to be submitted before the first of February 1901. The details can be obtained by addressing the Secretary.

THE world at large, and even many of those who are interested in the history of mechanical engineering, says the *Scientific American*, do not know that the body of the great engineer, Robert Fulton, lies in Trinity churchyard in New York City, being interred in the Livingston family vault. There is no mark or inscription to indicate its resting place. In view of the epoch making character of the work of Fulton, and of his eminence as an engineer, and of his indomitable perseverance in the development of steam navigation in the face of the greatest obstacles, it has been deemed desirable that his tomb should be marked by a suitable monument. The Council of the American Society of Mechanical Engineers had the matter brought to its attention at the Washington meeting last May. The idea was warmly welcomed, and a committee was appointed to investigate the proper method of accomplishing the suitable marking of the grave. The committee has found its efforts heartily met both by the Trinity corporation and by members of the Fulton family. The Society has been assured that a suitable place will be provided in Trinity churchyard for such a monument as may be erected, and that the remains of Fulton will be removed to such a place when the monument is ready. The Society possesses a number of memorials of Robert Fulton, including furniture, his portrait by his own hand, draw-

ings, autograph letters, and other personal relics. Indeed, it may be said that the Society is Fulton's literary heir. In view of this fact, the action of the Society is most dignified and fitting. A subscription is now being raised by it, and there is little question but that sufficient funds will be obtained to erect a most admirable memorial to mark the place where lies the body of one of the earliest and greatest of American engineers.

It is poetic justice that Fulton should continue to rest in the spot where he was interred. At the front of the quaint old burying ground run the cable cars, at the rear the electric cars and the elevated road, and at the foot of Rector Street, the other boundary, two of the fastest vessels on the bay make their landings. Almost across the street is one of the tallest buildings which has ever been erected, and Wall Street commences directly in front of the burying ground. What more fitting spot could be obtained for the resting place of one whose activities contributed in so large a degree to the progress which is so much in evidence immediately around the historic old church?

UNIVERSITY AND EDUCATIONAL NEWS.

THE University of Pennsylvania has received a gift of \$250,000 from the estate of the late H. H. Houston, formerly a trustee and a generous benefactor of the University. Fifty thousand dollars is to be used for the dormitory system; the remaining \$200,000 for such purposes as the trustees may desire.

PLANS have been filed for a new building for the Horace Mann School, the model school of Teachers College, Columbia University. The estimated cost is \$350,000; the building will occupy the block on Broadway between 120th and 121st Street, adjoining the College.

O. H. INGHAM, of La Crosse, Wis., has given \$15,000 toward the building of a new school of science for Ripon (Wis.) College.

THE new laboratories for bacteriology and pathological research at Mason University College, Birmingham, were opened on Wednesday, December 6th. Dr. E. Rickards gave £1,000 toward the equipment.